

FOURTH ANNUAL REPORT
OF THE
SUPERINTENDENT
FOR
SUPPRESSING THE GYPSY AND
BROWN-TAIL MOTHS.

JANUARY, 1909.



BOSTON:
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APPROVED BY
THE STATE BOARD OF PUBLICATION.

The Commonwealth of Massachusetts.

*To the Senate and House of Representatives of the Commonwealth of
Massachusetts.*

I present herewith for your consideration the fourth report on the work of suppressing the gypsy and brown-tail moths. Owing to the resignation of Superintendent A. H. Kirkland, on Dec. 1, 1908, which was deeply regretted by this office, the duty of submitting this report devolves upon me, as acting superintendent. This report is submitted in accordance with the provisions of chapter 381, Acts of 1905, and contains a statement of the results obtained during the year 1908, together with a record of expenditures and certain recommendations concerning the future needs of the work.

L. H. WORTHLEY,
Acting Superintendent.

JAN. 1, 1909.

ORGANIZATION.

L. HOWARD WORTHLEY, .	.	<i>Acting Superintendent.</i>
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FRANK A. BATES, .	.	<i>Field Agent, Western Division.</i>
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JOHN A. FARLEY, .	.	<i>Field Agent, Southern Division.</i>
CHARLES W. MINOTT, .	.	<i>Field Agent, Central Division.</i>
HARRY B. RAMSEY, .	.	<i>Field Agent, Worcester County Division.</i>
GEORGE A. SMITH, .	.	<i>Field Agent, Eastern Division.</i>

SCIENTIFIC STAFF.

C. H. FERNALD, Ph.D., .	.	<i>Consulting Entomologist.</i>
FRANKLIN H. MOSHER, .	.	<i>Entomologist in Charge of Laboratory.</i>
HERBERT P. JOHNSON, Ph.D., .	.	<i>Bacteriologist.</i>
H. D. HASKINS, B.S., .	.	<i>Consulting Chemist.</i>
C. G. BARNUM, M.S., .	.	<i>Chemist.</i>



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The Commonwealth of Massachusetts.

THE GYPSY AND BROWN-TAIL MOTHS.

The year 1908, from the entomological standpoint, has been a notable one in Massachusetts, for two reasons: first, the general severity of insect damage of all kinds; and second, the rapidity with which such damage developed. While the canker worm, tussock moth, elm-leaf beetle and a host of other insect pests were unusually abundant, no better illustration of the effect of abnormal climatic conditions on insect life can be found than was shown by the gypsy moth and the brown-tail moth during the past year. The winter was favorable to the successful hibernation of these insects. The spring opened early, and the warm, dry season, almost entirely free from rain, gave caterpillars nearly ideal conditions for their rapid development. At the same time, these conditions seemed decidedly adverse to the increase of certain fungous and bacterial diseases which have in recent years been of great assistance in killing off the caterpillars. At any rate, we did not receive the usual amount of help from these natural aids. These conditions brought about an early development and rapid increase of damage by the gypsy moth caterpillars in sections where it had not been possible to cover the territory thoroughly in treating the egg clusters, more particularly in woodlands, where nothing had been done but thinning preliminary to wholesale spraying operations. It is needless to say that all the resources of the department, as well as those of each badly infested city or town, were severely taxed in order to prevent widespread damage. We feel it to be greatly to the credit of the city and town organizations that they were able in nearly all cases to meet this emergency by well-planned spraying operations, and

to destroy the caterpillars in their early stages of growth. Their principal devastation was therefore confined to woodlands of low valuation, and the highway trees throughout the district and those on residential and farming property were protected. It is not probable that such another year will occur for some time; but the experience of the past summer showed plainly the importance of equipping each city and town with spraying outfits, adequate in number and power to deal thoroughly with such an emergency should it again arise.

During the year 1908 the fight against the gypsy and brown-tail moths has been carried on practically along the same lines as in the three preceding years, and with equally gratifying results. In the early part of the year it seemed important that the scouting operations which were begun in the fall of 1907 should be continued, so that we might determine more exactly the extent of the gypsy moth infestation in Massachusetts. This work was continued until April, about 100 trained men being thus employed. In several of the towns along the border of the previously known infested district a number of small colonies were located. During the summer months these colonies were given careful attention, since their complete extermination seemed entirely practicable. That this policy was a wise one has been proved by the results of the summer and fall work. In many of these small colonies no caterpillars were found, while in several others no egg clusters were found at the time of the fall inspection.

The residential sections in the badly infested central towns are in very good condition at this writing, and in nearly all of the cities and towns most excellent work has been done. We now have a large, well-trained force of men throughout the entire district, sufficient to enable us to conduct the work much more economically than has ever been possible before. As long as it was necessary to train and educate men in the details of the moth work in any given town, that work was necessarily very expensive. There are to-day in each city and town a considerable number of men who have had the benefit of this training and experience, and whose services can usually be obtained when needed.

The recommendations made in the last annual report were

in the main adopted by the General Court, and have been most helpful to the work of the department. There have been but few cities and towns where the necessary appropriations have not been made promptly, thus relieving this office of the duty of enforcing the provisions of the law. As far as has been ascertained, very little dissatisfaction from citizens has been experienced by city and town officials in carrying out the requirements of the law. The balance of approximately \$75,000, shown in the financial statement of Dec. 1, 1907, was used in part in reimbursements to cities and towns for the work of that year, and a portion carried forward to the 1908 account. This small balance, together with appropriations of \$300,000 for 1908, have been nearly all expended in this year's work.

The greatly improved conditions in the residential districts have permitted us to take up the work in woodlands on a larger scale than ever before, and thousands of acres of woodland have been protected from the ravages of the moths. In some cases this work has involved the thinning and spraying of trees over large areas. In other cases it has been necessary to inspect thousands of acres, locating the incipient colonies and then stamping them out; but we have made a substantial and as we believe a satisfactory beginning on the great woodland problem, which, after all, is the most serious feature of the gypsy moth infestation in Massachusetts. In several cities and towns where serious woodland infestations exist the citizens have awakened to the danger threatening their forests, and to the fact that the Commonwealth cannot in justice to the other towns in the district reimburse them its proportional part of the cost of the work necessary to be done to protect them from the gypsy moth. These towns and cities have in a most commendable spirit made additional appropriations from the municipal treasuries sufficient to provide for the necessary year's work. Notable examples of this are found at Weston and Lincoln, where several thousand dollars in excess of allotments from the central office have been spent. This generous policy has naturally encouraged the department to deal liberally with such towns, since it has been our constant policy from the beginning of the work to give the greatest measure of help to those who showed the greatest desire to help themselves.

The largest number of men engaged in the work at any time during the year was slightly over 2,400, — a larger force than has ever been similarly employed. There has been manifest on the part of property owners in general a commendable spirit of co-operation, particularly in the districts where the brown-tail moth was the principal insect to be combated. As might be expected, in sections where the insects have been reduced in numbers so that the damage by them is no longer noticeable, a certain degree of apathy on the part of property owners is beginning to be apparent. This is a repetition of the condition of affairs a decade ago. It is the present danger which we fear, — not the one through which we have safely passed. We believe that this attitude is an entirely wrong one, since it should be borne in mind that even a few gypsy moth egg clusters or a few brown-tail moth webs, if neglected, will within a few years increase to such numbers as to become a very present danger.

With the approval of the Governor, this office has contributed \$20,000 to a fund of \$50,000 which has been used in suppressing the gypsy moths in the north shore woods, in an effort to treat in its entirety this valuable section of woodland. The balance of the fund, \$30,000, has been raised through the energetic efforts of Col. William D. Sohier. A detailed account of the expenditure of this fund and the work accomplished will be found later in this report.

The work of importing and propagating parasites during the year 1908 has been prosecuted as vigorously as heretofore, with even better results, both in the laboratory and in the field. By the aid of the experts kindly furnished by the Bureau of Entomology, United States Department of Agriculture, working under the direction of Dr. L. O. Howard, many difficult and important problems in the life histories of these valuable insect allies have been worked out, and with certain species the method of their easy and rapid multiplication has been greatly simplified. Large numbers of the parasites of both the gypsy moth and the brown-tail moth have been liberated in various suitable localities, and are known to have become established, although, as might be expected, no practical results on a large scale have been perceived as yet.

SYNOPSIS OF THE REPORT.

1. In spite of the unusual climatic conditions favoring the increase of the gypsy and brown-tail moths in 1908, the local organizations as a rule have shown themselves able to keep the insects under control except in the woodland districts, where lack of funds do not permit extensive operations.

2. The policy of cleaning the trees along the streets and highways and in residential and farming sections has been continued, with satisfactory results.

3. A special effort has been made to protect the north shore woodlands through a co-operative plan of work, the greater portion of the funds for these operations being provided by the interested citizens and municipalities.

4. A satisfactory spirit of co-operation has been shown by city and town officials as a whole, and by citizens of the infested district.

5. Greater progress has been made in the importation and rearing of parasites of the gypsy and brown-tail moths during 1908 than in any single year heretofore.

Recommendations are:—

1. To continue the field work at its maximum efficiency, an appropriation of \$150,000, in addition to that already provided for the year 1909, should be made.

2. To continue the work of importation of parasites and for work on fungous and bacterial diseases an appropriation of \$15,000, in addition to any unexpended balance, should be made.

3. To provide for the uninterrupted continuation of the work against the gypsy and brown-tail moths, that the work may not suffer from legislative delays in the winter and spring, when most effective work can be done, a suitable appropriation should be made for a period of at least three years.

FINANCIAL STATEMENT.

As explained in previous reports, although the law requires the superintendent to "separate, as far as practicable, the expenditures on work against the gypsy moth from those on work against the brown-tail moth," this is an impossible require-

ment. The winter work against both the brown-tail moth and the gypsy moth is done by the same gang of men and at the same time. When a man goes into a tree, he clears it of both brown-tail moth webs and gypsy moth egg clusters, and to make such a separation as required would involve an endless amount of bookkeeping, as well as an enormous expense.

As far as possible, we have obtained complete returns from all cities and towns showing their expenditures in the work against the gypsy and brown-tail moths up to the close of the fiscal year, Nov. 30, 1908. There are, as usual, a certain number of dilatory municipalities whose accounts are not yet made up, while in other cases certain items of expense which appear to be open to question are held pending adjustment. As previously mentioned, the balance carried forward from Nov. 30, 1907, \$75,734.83, was largely paid out in reimbursement to towns which had failed to make returns at the time of closing the books. For the same reason, the balance of \$1,223.37 on hand Nov. 30, 1908, is apparent rather than real, and will doubtless be disbursed during the current month.

General appropriation:—

Balance from 1907,	\$75,734 83	
Appropriation for 1908,	150,000 00	
Appropriation of June 8, 1908,	150,000 00	
Credit for cash returned,	10 85	
		<hr/> \$375,745 68

Office expenses:—

Management,	\$5,000 00
Salaries of clerks,	2,402 00
Rent,	1,440 00
Stationery and postage,	1,137 09
Printing,	949 42
Experts,	248 15
Supplies and furniture,	131 88
Sundries,	1,182 44
Educational work,	40 75

Field expenses:—

Wages of employees,	72,057 06
Travelling expenses of employees,	13,470 00
Supplies,	583 22

Amounts carried forward, \$98,642 01 \$375,745 68

<i>Amounts brought forward,</i> . . .	\$98,642 01	\$375,745 68
Special work in parks, etc., . . .	123,713 71	
Supplies for experiments, . . .	98 05	
Emergency work, . . .	228 00	
Reimbursements to cities and towns, . .	251,703 17	
Sundries, . . .	137 37	
	<hr/>	374,522 31
Balance Nov. 30, 1908, . . .		\$1,223 37

PARASITE APPROPRIATION.

We have endeavored to handle the appropriation for this part of our work economically, and yet at the same time have not hesitated to make relatively large expenditures where the probability of securing desirable results seemed to warrant them. The one large item of expense in this connection was a trip to Japan, made by Prof. Trevor Kincaid in search of parasites of the Japanese gypsy moth. The results of his trip have amply justified the outlay, and we have obtained from Japan parasites which we believe will prove to be of enormous value in destroying the egg clusters of the gypsy moth. The total expenses incurred in this work during the year 1908 are given below:—

Balance from 1907, . . .	\$10,325 88	
Appropriation of June 8, 1908, . . .	25,000 00	
	<hr/>	\$35,325 88
Expenditures:—		
Wages of employees, . . .	\$5,804 39	
Travelling expenses of employees, . .	2,120 06	
Rent, . . .	505 00	
Supplies, . . .	1,964 17	
Stationery and postage, . . .	47 98	
Printing, . . .	65 39	
Experts, . . .	91 57	
Sundries, . . .	588 73	
Importation of parasites, . . .	5,208 50	
	<hr/>	16,395 79
Balance Nov. 30, 1908, . . .		\$18,930 09

¹ This amount includes \$20,000 contributed by this department to special north shore fund. For expenditures under this fund, see page 48.

ANALYSIS OF TOWN EXPENSES.

The only item in the subjoined analysis of town expenses requiring any particular explanation is the relatively large outlay for supplies. A large item in this class of expenses is caused by the purchase of power spraying outfits. In the years during which this department has directed the work against the moths a great deal of preliminary work, such as thinning of trees, cutting of brush, removal of decayed trees, etc., has been done. A very large part of the territory is now in condition to be treated mainly by spraying, which is the most economical single method of fighting the moths. Furthermore, we are now taking up generally throughout the district the suppression of the moths in woodlands, — work which can best be done by spraying; hence it has seemed desirable to have the cities and towns as far as funds would permit equip themselves with large power sprayers, to the end that their future operations may be carried on more economically and more effectively. The total amount spent in 94 towns and cities, receiving reimbursement from the State to the amount of \$247,733.84, may be distributed as follows: —

Total amount spent,	\$521,753 31	
Private work deducted,	91,183 53	
	<hr/>	\$430,569 78
Pay roll,	\$336,751 91	
Teaming,	16,373 38	
Travel,	1,204 45	
Rent,	646 25	
Supplies,	70,882 25	
Sundries,	2,993 89	
Stationery and postage,	921 71	
Printing,	795 94	
	<hr/>	\$430,569 78

FINANCIAL SUMMARY BY TOWNS.

The following table shows the expenditures required of cities and towns before receiving reimbursement from the State, and the total net expenditure and reimbursement of each city and town in the infested gypsy moth district for 1907 and 1908.

The columns for 1907 include all reimbursements on account of work done during that year, some of which had not been made at the time the report for 1907 went to press.

	1907.			1908.		
	Required Expendi- ture.	Total Expendi- ture.	Re- imburse- ment.	Required Expendi- ture.	Total Expendi- ture.	Re- imburse- ment.
Abington, . .	\$1,043 29	—	—	\$1,112 52	\$2,605 96	\$1,493 44
Acton, . .	702 95	\$2,960 67	\$2,257 82	719 42	3,205 23	2,485 81
Amesbury, . .	2,092 90	1,086 52	—	2,331 90	2,710 00	378 10
Andover, . .	2,410 05	3,685 76	1,020 57	2,485 53	5,441 99	2,365 17
Arlington, . .	4,046 34	11,450 02	5,993 94	4,355 02	11,991 38	6,109 09
Ashby, . .	—	—	—	202 69	98 36	—
Ashland, . .	414 44	740 59	326 15	437 73	778 97	341 24
Attleborough, . .	—	—	—	5,000 00	306 40	—
Avon, . .	363 40	—	—	382 54	105 21	—
Ayer, . .	717 22	—	—	803 29	—	—
Auburn, . .	—	—	—	429 40	—	—
Barnstable, . .	2,002 04	—	—	2,162 12	—	—
Bedford, . .	492 97	6,533 22	6,040 25	514 05	9,980 77	9,466 72
Bellingham, . .	—	—	—	325 77	37 23	—
Belmont, . .	2,249 64	5,411 51	3,161 87	2,397 97	2,970 90	572 93
Berlin, . .	216 08	280 95	64 87	218 75	679 58	460 83
Beverly, . .	5,000 00	8,244 88	1,622 45	5,000 00	8,779 19	1,889 61
Billerica, . .	878 28	4,189 78	3,311 50	898 36	6,989 45	6,091 09
Bolton, . .	195 16	417 54	222 38	196 49	607 56	411 07
Boston, . .	5,000 00	10,909 76	—	5,000 00	10,481 43	—
Bourne, . .	1,081 86	—	—	1,333 71	2,822 72	1,489 01
Boxborough, . .	97 09	1,013 37	916 28	100 85	1,906 38	1,805 43
Boxford, . .	438 84	1,800 75	1,361 91	471 26	2,537 61	2,066 35
Braintree, . .	1,989 47	—	—	2,256 42	3,801 69	—
Bridgewater, . .	1,257 56	—	—	1,298 95	860 27	—
Brockton, . .	5,000 00	—	—	5,000 00	500 00	—
Brookline, . .	5,000 00	—	—	5,000 00	—	—
Burlington, . .	232 50	4,068 44	3,835 94	243 93	5,843 37	5,599 44
Cambridge, . .	5,000 00	{ 3,260 99 983 56	380 50	} 5,000 00	4,881 03	—
Canton, . .	1,541 40	—	—			
Carlisle, . .	164 96	3,276 29	3,111 33	166 48	5,652 06	5,485 58
Carver, . .	549 31	645 78	96 47	527 74	4,169 01	3,641 27
Chelmsford, . .	1,248 16	4,265 09	3,016 93	1,319 36	5,060 34	3,740 98
Chelsea, . .	5,000 00	—	—	5,000 00	1,455 90	—

	1907.			1908.		
	Required Expendi- ture.	Total Expendi- ture.	Re- imburse- ment.	Required Expendi- ture.	Total Expendi- ture.	Re- imburse- ment.
Clinton, . .	\$3,211 14	-	-	\$3,178 27	\$1,817 24	-
Cohasset, . .	2,601 07	\$2,883 59	\$226 02	2,859 28	4,029 78	\$936 40
Concord, . .	2,233 87	5,755 78	3,521 91	2,450 48	8,912 55	5,169 66
Danvers, . .	2,183 64	7,630 23	5,446 59	2,284 22	8,725 93	6,441 71
Dedham, . .	4,461 35	-	-	4,821 53	327 34	-
Dennis, . .	-	-	-	474 40	78 55	-
Dover, . .	393 63	2,030 42	1,636 79	470 45	1,958 01	1,487 56
Dracut, . .	862 81	1,260 03	397 22	876 41	3,339 02	2,462 61
Dunstable, . .	116 03	814 43	698 40	118 04	662 71	544 67
Duxbury, . .	772 63	1,680 63	908 00	857 10	4,239 01	3,381 91
East Bridgewater, .	664 79	1,417 46	752 67	693 46	4,639 24	3,945 78
Easton, . .	1,947 96	-	-	2,022 12	391 24	-
Essex, . .	422 27	2,198 84	1,776 57	430 86	2,527 08	2,096 22
Everett, . .	5,000 00	2,542 22	-	5,000 00	2,420 52	-
Falmouth, . .	3,128 51	-	-	3,167 28	674 56	-
Fitchburg, . .	-	-	-	5,000 00	-	-
Foxborough, . .	-	-	-	882 40	34 25	-
Framingham, . .	3,800 82	5,252 12	1,161 04	3,911 86	3,554 97	-
Franklin, . .	-	-	-	1,463 10	67 64	-
Gardner, . .	-	-	-	2,798 77	-	-
Georgetown, . .	394 98	1,033 92	638 94	403 76	1,555 43	1,151 67
Gloucester, . .	5,000 00	6,506 28	753 14	5,000 00	9,127 08	2,063 54
Grafton, . .	-	-	-	1,068 13	365 33	-
Greenfield, . .	-	-	-	3,252 63	-	-
Groton, . .	1,205 98	-	-	1,199 52	736 34	-
Groveland, . .	441 45	1,345 15	903 70	465 21	2,176 31	1,711 10
Halifax, . .	134 03	735 18	601 15	187 69	2,425 52	2,237 83
Hamilton, . .	1,186 10	3,432 79	2,246 69	1,378 11	4,545 74	3,167 63
Hanover, . .	551 55	1,938 89	1,387 34	569 46	4,624 06	4,054 60
Hanson, . .	366 28	796 46	430 18	501 40	2,372 79	1,871 39
Harvard, . .	437 53	139 32	-	520 36	1,136 97	616 61
Haverhill, . .	5,000 00	2,618 23	-	5,000 00	7,263 23	1,131 62
Hingham, . .	1,778 16	3,773 46	1,994 80	2,323 90	4,201 05	1,877 15
Holbrook, . .	511 06	215 76	-	547 06	247 00	-
Holden, . .	-	-	-	574 20	-	-
Holliston, . .	618 46	-	-	626 53	178 58	-
Hopkinton, . .	649 77	816 60	166 83	623 27	1,433 43	810 16

	1907.			1908.		
	Required Expendi- ture.	Total Expendi- ture.	Re- imburse- ment.	Required Expendi- ture.	Total Expendi- ture.	Re- imburse- ment.
Hudson, . . .	\$1,276 38	\$2,536 01	\$1,259 63	\$1,365 55	\$2,365 14	\$999 59
Hull, . . .	1,860 36	—	—	2,033 99	707 50	—
Hyde Park, . .	5,000 00	—	—	5,000 00	2,836 09	—
Ipswich, . . .	1,545 93	3,309 01	1,762 08	1,651 95	3,409 75	1,757 80
Kingston, . . .	583 56	287 77	—	667 67	1,528 67	861 00
Lakeville, . . .	252 84	—	—	265 24	—	—
Lawrence, . . .	5,000 00	—	—	5,000 00	—	—
Leicester, . . .	—	—	—	913 02	57 85	—
Leominster, . .	3,769 99	252 00	—	4,059 74	519 25	—
Lexington, . . .	2,390 50	15,109 67	10,796 87	2,483 92	16,408 91	11,139 99
Lincoln, . . .	1,019 01	3,804 70	2,785 69	1,147 93	8,507 18	5,000 00
Littleton, . . .	396 95	684 39	287 44	406 74	2,122 75	1,716 01
Lowell, . . .	5,000 00	—	—	5,000 00	5,054 54	—
Lunenburg, . . .	400 47	—	—	410 74	492 08	81 34
Lynn, . . .	{ 2,500 00 5,000 00	{ 6,400 58 12,695 42	{ 3,900 58 3,847 72	{ 5,000 00	{ 6,168 53 ¹ 2,548 23	{ 3,034 27 —
Lynnfield, . . .	295 30	3,569 68	3,274 38	298 50	3,280 95	2,982 45
Malden, . . .	5,000 00	10,367 13	2,683 57	5,000 00	3,971 90	—
Manchester, . .	4,302 18	—	—	4,732 48	4,705 33	—
Marblehead, . .	2,891 82	2,450 91	—	2,946 27	1,718 54	—
Marion, . . .	—	—	—	1,016 64	225 75	—
Marlborough, . .	3,856 47	{ 2,965 10 469 67	{ 855 44 —	{ 3,955 73	{ 4,681 77	{ 580 83
Marshfield, . . .	673 59	842 96	170 37	752 57	3,141 82	2,389 25
Mashpee, . . .	—	—	—	76 48	181 25	104 77
Maynard, . . .	1,426 30	2,498 36	1,072 06	1,492 94	3,044 22	1,551 28
Medfield, . . .	613 01	—	—	618 44	166 54	—
Medford, . . .	5,000 00	11,235 36	3,117 68	5,000 00	13,012 21	4,006 11
Medway, . . .	—	—	—	538 74	137 74	—
Melrose, . . .	5,000 00	7,771 21	1,416 26	5,000 00	2,709 06	—
Merrimac, . . .	495 08	684 48	189 40	491 33	2,089 35	1,598 02
Methuen, . . .	2,073 56	3,844 35	1,770 79	2,236 41	5,570 41	3,334 00
Middleborough, .	1,696 37	—	—	1,764 24	1,810 64	—
Middleton, . . .	276 30	1,867 74	1,591 44	303 19	2,147 61	1,844 42
Milford, . . .	2,567 49	—	—	2,670 12	14 32	—
Millbury, . . .	—	—	—	921 54	591 23	—
Millis, . . .	291 71	—	—	301 45	296 82	—
Milton, . . .	5,000 00	—	—	5,000 00 ²	6,714 83	—
Nahant, . . .	2,182 80	—	—	2,265 18	—	—

¹ Lynn woods.² No papers submitted.

	1907.			1908.		
	Required Expendi- ture.	Total Expendi- ture.	Re- imburse- ment.	Required Expendi- ture.	Total Expendi- ture.	Re- imburse- ment.
Natick, . .	\$2,652 69	\$6,313 48	\$2,928 64	\$2,740 16	\$8,507 10	\$4,613 56
Needham, . .	1,709 15	2,073 93	364 78	2,074 91	4,518 75	2,443 84
Newbury, . .	488 56	2,390 90	1,902 35	500 20	5,687 39	5,187 19
Newburyport, . .	4,394 09	3,284 53	-	4,508 12	3,533 46	-
Newton, . .	5,000 00	6,522 72	761 36	5,000 00	10,451 33	2,730 67
Norfolk, . .	-	-	-	311 18	440 57	-
North Andover, . .	1,803 34	1,517 19	-	1,806 55	5,044 78	3,238 23
North Reading, . .	267 68	2,183 49	1,915 81	269 25	3,026 51	2,757 26
Northbridge, . .	-	-	-	1,595 69	-	-
Norwell, . .	332 95	840 36	507 41	349 23	2,640 80	2,291 57
Norwood, . .	2,153 65	-	-	2,404 95	-	-
Orleans, . .	236 63	-	-	244 08	96 30	-
Oxford, . .	-	-	-	735 47	60 82	-
Palmer, . .	-	-	-	1,585 28	17 08	-
Peabody, . .	3,576 56	8,573 33	3,997 42	3,843 73	9,104 57	4,208 67
Pembroke, . .	374 78	483 23	108 45	380 34	1,490 06	1,109 72
Pepperell, . .	884 80	-	-	893 90	1,764 69	870 79
Plainville, . .	-	-	-	291 84	-	-
Plymouth, . .	3,829 92	-	-	4,095 44	-	-
Plympton, . .	131 09	791 16	660 07	130 71	5,635 58	5,504 87
Princeton, . .	-	-	-	413 75	40 50	-
Quincy, . .	5,000 00	4,781 38	-	5,000 00	8,100 47	1,550 24
Randolph, . .	799 00	-	-	790 94	221 52	-
Raynham, . .	293 70	83 57	-	297 58	368 38	70 80
Reading, . .	1,886 39	7,846 05	5,959 66	1,996 61	8,970 91	6,974 30
Revere, . .	4,939 44	5,557 60	370 90	5,000 00	3,182 36	-
Rochester, . .	-	-	-	249 56	345 90	96 34
Rockland, . .	1,363 81	-	-	1,403 65	2,078 82	675 17
Rockport, . .	1,227 31	2,070 11	842 80	1,232 16	2,032 50	800 34
Rowley, . .	295 72	988 17	692 45	299 19	1,346 92	1,047 73
Salem, . .	5,000 00	12,828 02	3,914 01	5,000 00	10,637 34	2,818 68
Salisbury, . .	332 53	2,141 61	1,809 08	331 91	2,435 82	2,103 91
Sandwich, . .	390 92	-	-	393 18	887 26	494 08
Saugus, . .	1,814 66	14,909 27	13,094 61	2,274 83	14,518 13	12,243 30
Scituate, . .	1,500 63	-	-	1,676 63	1,600 94	-
Sharon, . .	-	-	-	1,015 19	178 82	-
Sherborn, . .	441 09	1,240 14	799 05	538 11	2,001 93	1,463 82

	1907.			1908.		
	Required Expendi- ture.	Total Expendi- ture.	Re- imburse- ment.	Required Expendi- ture.	Total Expendi- ture.	Re- imburse- ment.
Shirley, . .	\$378 12	—	—	\$418 69	\$241 08	—
Shrewsbury, . .	—	—	—	584 13	198 43	—
Somerville, . .	5,000 00	\$4,257 79	—	5,000 00	4,367 32	—
Southborough, . .	587 06	2,083 01	\$1,495 95	683 93	—	—
Springfield, . .	—	—	—	5,000 00	56 38	—
Stoneham, . .	1,951 61	9,947 90	7,996 29	1,982 77	10,035 25	\$8,052 48
Stoughton, . .	1,319 37	187 41	—	1,374 63	—	—
Stow, . .	332 73	798 20	465 47	352 45	1,126 25	773 80
Sudbury, . .	482 93	1,015 87	532 94	520 46	2,911 06	2,390 60
Sutton, . .	—	—	—	484 95	69 94	—
Swampscott, . .	3,218 55	4,444 58	980 22	3,726 99	5,612 61	1,509 10
Taunton, . .	—	—	—	5,000 00	573 07	—
Tewksbury, . .	551 08	1,737 84	1,186 76	440 77	2,212 46	1,771 69
Topsfield, . .	397 69	2,426 19	2,028 50	429 63	2,154 89	1,725 26
Townsend, . .	—	—	—	456 95	112 52	—
Truro, . .	—	—	—	149 78	—	—
Tyngsborough, . .	186 05	1,300 79	1,114 74	205 64	1,711 02	1,505 38
Upton, . .	—	—	—	430 25	237 28	—
Wakefield, . .	3,340 26	6,176 49	2,263 99	3,347 02	8,719 30	4,297 83
Walpole, . .	1,422 07	—	—	1,641 18	76 52	—
Waltham, . .	5,000 00	7,209 45	1,104 73	5,000 00	11,680 24	3,340 13
Wareham, . .	1,361 91	—	—	1,457 01	840 06	—
Warren, . .	—	—	—	739 22	58 35	—
Watertown, . .	4,931 91	6,997 11	1,264 66	5,000 00	5,798 72	399 36
Wayland, . .	776 73	1,510 75	734 02	785 65	5,388 65	4,603 00
Webster, . .	—	—	—	2,564 02	—	—
Wellesley, . .	4,721 43	3,188 79	—	5,000 00	6,174 84	587 42
Wellfleet, . .	—	—	—	413 25	50 33	—
Wenham, . .	848 86	2,900 65	2,051 79	912 17	2,490 12	1,577 95
West Bridgewater, . .	448 07	1,086 72	638 65	475 50	1,817 67	1,342 17
West Newbury, . .	414 60	1,573 12	1,158 52	423 73	7,739 93	7,316 20
Westborough, . .	1,229 45	—	—	1,269 89	656 07	—
Westford, . .	649 21	2,350 70	1,701 49	670 12	3,397 53	2,727 41
Westminster, . .	—	—	—	294 85	183 83	—
Weston, . .	2,231 64	5,169 97	2,938 33	2,365 77	18,861 30	10,541 99
Westwood, . .	833 40	—	—	863 64	424 14	—
Weymouth, . .	2,803 52	4,129 56	1,060 83	2,907 63	4,836 21	1,542 86

	1907.			1908.		
	Required Expendi- ture.	Total Expendi- ture.	Re- imburse- ment.	Required Expendi- ture.	Total Expendi- ture.	Re- imburse- ment.
Whitman, . .	\$1,639 90	—	—	\$1,814 79	—	—
Wilmington, .	495 26	\$2,393 20	\$1,897 94	508 97	\$4,312 48	\$3,803 51
Winchester, .	4,202 25	10,526 11	5,059 09	4,404 26	5,414 36	808 08
Winthrop, . .	3,698 65	—	—	4,031 23	1,918 57	—
Woburn, . . .	4,307 33	9,632 01	4,252 45	4,361 81	13,892 55	7,624 59
Worcester, . .	5,000 00	—	—	5,000 00	398 66	—
Wrentham, . .	—	—	—	461 79	—	—
Yarmouth, . .	732 80	—	—	806 63	254 83	—

ALLOTMENTS OF APPROPRIATIONS.

The distribution of our appropriation among the various infested cities and towns is a matter to which we have given considerable thought, in order that we may place the money where it will do the most good. It has always been the policy of this office to assist those who show a desire to help themselves, and we feel that this course of action should be continued. In some cities and towns, where the work has not been well done, we did not deem it advisable to make large allotments; on the other hand, where the work done was of a high quality, we felt that we should give assistance as far as our funds would permit.

The first allotment of expenditures for the year was made in the latter part of November, 1907, and at that time complete returns had not been received from all cities and towns; therefore, we were obliged to reserve all balance from 1907 for reimbursements. Later in the year we received a further appropriation from the Legislature, and additional allotments were made to cities and towns in need of money. The municipalities doing moth work the past season have in most cases realized their danger more than ever before, and have expended all the money allotted them. The coming season it will not be necessary to make any allotments from the appropriations for this office to several of the municipalities that have received reimbursement in the past, as their territory is in such a condition that the proper care of it in the future will not necessitate the expenditure of more than their liability. There are many places, however,

where extensive woodland operations are necessary for protection, and here large amounts of money can be well used. The increased number of power spraying outfits in the field will have to be taken into consideration in making allotments for 1909.

ACKNOWLEDGMENTS.

In previous years we have freely sought advice from those best qualified to give it, as the exigencies of the work demanded. It is impossible to mention the many good friends of the work in which we are engaged, who have helped by suggestion or counsel. We are particularly indebted, however, for helpful advice to the Honorable Attorney-General, the Honorable Auditor to the Commonwealth, the secretary of the Board of Agriculture, the officials of the Massachusetts Association for the Suppression of Gypsy and Brown-tail Moths, and also to Prof. C. H. Fernald, Col. W. D. Sohier and others. Finally, we are glad to acknowledge the loyal and efficient assistance given at all times by secretary C. O. Bailey, and field agents F. A. Bates, J. W. Enwright, J. A. Farley, C. W. Minott, Harry B. Ramsey and George A. Smith. Our thanks are also due to the officials of the various cities and towns, to the local moth superintendents and to the inspectors and other employees of the central office, for faithful service and hearty co-operation.

SCOUTING WORK.

At the beginning of the year 1908 it seemed necessary to continue the scouting on as large a scale as during the fall of 1907, as the extent of the infestation by the gypsy moth had not been sufficiently well determined. In nearly all of the towns which had been scouted egg clusters of the gypsy moth were found, and it seemed necessary to continue until the border of the infestation was known. This work was continued until May 16, approximately 100 men being employed. The men engaged in this work were well trained and had a thorough knowledge of gypsy moth scouting, as the local officials in towns bordering on known infestations were not well enough acquainted with the habits of the gypsy moth to scout their own towns thoroughly. The results obtained by our scouting gangs were so satisfactory that we feel that the Commonwealth and the cities and towns

thus scouted were both benefited by the work which was done. We have found it much easier to handle small infestations thus found than the larger colonies reported to this office by people who have been annoyed by the pest. In nearly all cases the infestations were located in orchards and decayed apple trees.

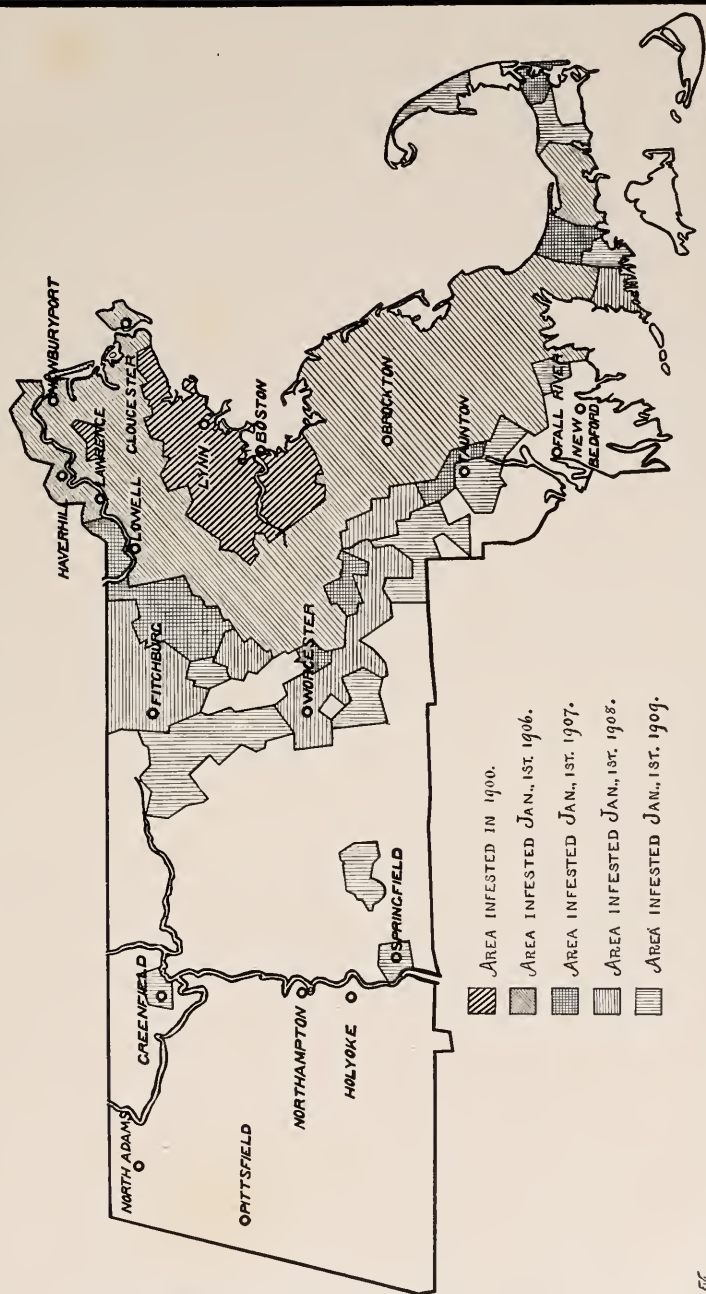
The following towns were found to be infested by the gypsy moth: —

Attleborough.	Mansfield.	Taunton.
Bellingham.	Mashpee.	Templeton.
Brewster.	Norfolk.	Wrentham.
Dennis.	Oxford.	Wellfleet.
Foxborough.	Princeton.	Westminster.
Gardner.	Rochester.	
Lancaster.	Sutton.	

It was also deemed advisable to scout the main road from Worcester to Springfield, and infestations were found in Warren, Palmer and Springfield. The main road leading to Hartford from Springfield was scouted as far as the Connecticut line, nothing being found outside of Springfield. Also, following up the Connecticut valley on the main highways, one egg cluster was found, in Greenfield. The State highway leading from Springfield to Westfield and Huntington was also inspected, but nothing was found. The following towns were inspected, but no gypsy moth infestations were found: —

Agawam.	Granby.	Russell.
Amherst.	Hadley.	Rutland.
Ashburnham.	Hatfield.	Seekonk.
Athol.	Holyoke.	South Hadley.
Auburn.	Hubbardston.	Southbridge.
Barre.	Huntington.	Spencer.
Blackstone.	Longmeadow.	Swansea.
Brookfield.	North Attleborough.	Uxbridge.
Charlton.	North Brookfield.	Webster.
Chicopee.	Northampton.	West Brookfield.
Deerfield.	Norton.	West Springfield.
Douglas.	Orange.	Westfield.
Dudley.	Paxton.	Whately.
Easthampton.	Pittsfield.	Wilbraham.
Fall River.	Rehoboth.	

The policy of this office will be to continue the scouting operations on a small scale the coming year, especially in towns located



MAP SHOWING AREA INFESTED BY GYPSY MOTH JAN. 1, 1909.

inside the infested territory, as there is great danger of such towns becoming infested, that we may determine their condition at as early a date as possible. In some municipalities, where the infestation is slight and the work is not receiving proper attention from the local authorities, it may be advisable to make a thorough scout, that we may determine their condition, and be able to present the case to the local officials as it really is, thus making them understand the necessity of prosecuting the work vigorously.

LIST OF INFESTED TOWNS.

A complete list of cities and towns known to be infested by the gypsy moth Jan. 1, 1909, together with the liability under the act of each for 1909, and the name of the local superintendent of moth work in each town, is appended: —

TOWN OR CITY.	Liability.	Local Superintendent.
Abington,	\$1,118 96	C. Frederick Shaw.
Acton,	722 99	Charles J. Williams.
Amesbury,	2,348 81	A. L. Stover.
Andover,	2,476 21	James H. Playdon.
Arlington,	4,442 02	William H. Bradley.
Ashby,	198 77	H. A. Lawrence.
Ashland,	470 02	Frank A. Morse.
Attleborough,	5,000 00	Wm. E. S. Smith.
Avon,	377 28	Willard W. Beals.
Ayer,	815 53	Loring A. Carman.
Barnstable,	2,277 15	Harry W. Bodfish.
Bedford,	520 30	W. A. Cutler.
Bellingham,	325 46	Henry A. Whitney.
Belmont,	2,431 46	Chas. F. Houlahan.
Berlin,	223 62	Willis Rice.
Beverly,	5,000 00	Josiah B. Brown.
Billerica,	909 78	Francis J. Dolan.
Bolton,	178 02	Charles E. Mace.
Boston,	5,000 00	D. Henry Sullivan.
Bourne,	1,356 60	Stillman B. Wright.
Boxborough,	99 58	John J. Sherry.
Boxford,	479 97	Charles Perley.
Braintree,	2,319 73	E. E. Abercrombie.

TOWN OR CITY.	Liability.	Local Superintendent.
Brewster,	\$210 63	Moses Wiles.
Bridgewater,	1,300 09	Robert J. McNeeland.
Brockton,	5,000 00	Edward Mottau.
Brookline,	5,000 00	Ernest B. Dane.
Burlington,	246 52	Walter W. Skelton.
Cambridge,	5,000 00	J. F. Donnelly.
Canton,	1,596 06	Augustus Hemenway.
Carlisle,	176 58	G. G. Wilkins.
Carver,	558 34	Herbert F. Atwood.
Chelmsford,	1,635 35	George B. B. Wright.
Chelsea,	5,000 00	J. A. O'Brien.
Clinton,	3,218 88	Michael Monahan.
Cohasset,	2,817 53	Joseph E. Grassie.
Concord,	2,551 71	H. P. Richardson.
Danvers,	2,352 60	Thomas E. Tinsley.
Dedham,	5,000 00	George A. Phillips.
Dennis,	475 87	H. H. Sears.
Dover,	560 85	G. H. Thompson.
Dracut,	919 20	Chester B. Colburn.
Dunstable,	119 46	James A. Davis.
Duxbury,	1,025 48	Henry A. Fish.
East Bridgewater,	786 16	William T. Greene.
Easton,	2,031 17	R. W. Melendy.
Essex,	436 53	Otis O. Storey.
Everett,	5,000 00	James Davidson.
Falmouth,	3,201 00	W. B. Bosworth.
Fitchburg,	5,000 00	Geo. H. Hastings.
Foxborough,	883 73	Frank C. Carpenter.
Framingham,	4,035 02	N. I. Bowditch.
Franklin,	1,476 97	Thomas Keefe.
Gardner,	2,942 78	T. W. Danforth.
Georgetown,	412 67	Edward J. Watson.
Gloucester,	5,000 00	W. D. Corliss.
Grafton,	1,069 86	Charles K. Despeau.
Greenfield,	3,645 72	William A. Ames.
Groton,	1,235 99	William Woods.
Groveland,	466 03	Moses M. Jaques.
Halifax,	205 39	Frank D. Lyon.
Hamilton,	1,441 27	Fred A. Nason.
Hanover,	577 74	Lyman Russell.

TOWN OR CITY.	Liability.	Local Superintendent.
Hanson,	\$511 66	A. L. Dame.
Harvard,	481 67	George C. Maynard.
Haverhill,	5,000 00	George F. Moore.
Hingham,	2,307 82	Arthur W. Young.
Holbrook,	567 83	William Hayden.
Holden,	600 78	J. W. Rice.
Holliston,	630 30	Frank Cass.
Hopkinton,	618 44	Wm. A. Macmillan.
Hudson,	1,403 84	John E. Walsh.
Hull,	2,070 90	Smith F. Sturgis.
Hyde Park,	5,000 00	Harry G. Higbee.
Ipswich,	1,744 32	James A. Morey.
Kingston,	623 16	Carl C. Faunce.
Lakeville,	270 16	S. T. Nelson.
Lancaster,	1,461 23	John E. Thayer.
Lawrence,	5,000 00	William Howarth.
Leicester,	944 95	John J. Quinn.
Leominster,	4,210 52	S. R. Walker.
Lexington,	2,753 87	E. P. Merriam.
Lincoln,	1,124 13	Edward R. Farrar.
Littleton,	412 83	Alfred Hopkins.
Lowell,	5,000 00	Charles A. Whittet.
Lunenburg,	422 49	Stephen Farnsworth.
Lynn,	5,000 00	Albert C. Doak.
Lynnfield,	311 21	Alfred W. Copeland.
Malden,	5,000 00	George W. Stiles.
Manchester,	5,000 00	John D. Morrison.
Mansfield,	1,198 63	W. O. Sweet.
Marblehead,	2,987 21	Wm. H. Stevens, 2d.
Marion,	1,148 28	James H. Morss.
Marlborough,	4,021 23	M. E. Lyons.
Marshfield,	745 86	P. R. Livermore.
Mashpee,	80 22	Watson F. Hammond.
Maynard,	1,513 59	Albert Coughlin.
Medfield,	617 18	George L. L. Allen.
Medford,	5,000 00	Wm. J. Gannon.
Medway,	538 39	Frank Hager.
Melrose,	5,000 00	John J. McCullough.
Merrimac,	489 88	Frank E. Bartlett.
Methuen,	2,365 39	Alfred H. Wagland.

TOWN OR CITY.	Liability.	Local Superintendent.
Middleborough,	\$1,811 04	John C. Chase.
Middleton,	307 67	Benj. T. McGlaulin.
Milford,	2,800 46	Patrick F. Fitzgerald.
Millbury,	920 07	Edward F. Roach.
Millis,	320 32	Harris W. Alden.
Milton,	5,000 00	Nathaniel T. Kidder.
Nahant,	2,373 87	Thos. Roland.
Natick,	2,899 84	H. H. Hunnewell.
Needham,	2,262 22	Ernest E. Riley.
Newbury,	499 53	O. B. Tarbox.
Newburyport,	4,581 48	Charles P. Kelly.
Newton,	5,000 00	Charles I. Bucknam.
Norfolk,	322 73	C. Albert Murphy.
North Andover,	1,850 27	Peter Holt.
North Reading,	270 66	George E. Eaton.
Northbridge,	1,699 24	Arthur F. Whitin.
Norwell,	358 21	John H. Sparrell.
Norwood,	2,440 26	H. Frank Winslow.
Orleans,	245 67	Albert A. Smith.
Oxford,	747 67	Herbert E. Lovett.
Palmer,	1,629 01	C. H. Keith.
Peabody,	4,039 62	James F. Callahan.
Pembroke,	388 47	Calvin S. West.
Pepperell,	895 60	Jos. A. Wiley.
Plainville,	299 98	Geo. Cheever.
Plymouth,	4,179 44	George R. Briggs.
Plympton,	134 06	Zina E. Sherman.
Princeton,	416 55	J. Harry Allen.
Quincy,	5,000 00	Randolph C. Bainbridge.
Randolph,	802 52	James E. Blanche.
Raynham,	301 45	George M. Leach.
Reading,	2,095 45	Guy A. Hubbard.
Revere,	5,000 00	William G. Cook.
Rochester,	250 74	- -
Rockland,	1,511 99	Frank H. Shaw.
Rockport,	1,276 78	Eli Gott.
Rowley,	299 42	Daniel O'Brien.
Salem,	5,000 00	Amos Stillman.
Salisbury,	359 39	Charles M. Pike.
Sandwich,	400 10	B. F. Denison.

TOWN OR CITY.	Liability.	Local Superintendent.
Saugus,	\$2,054 48	Thomas E. Berrett.
Scituate,	1,661 85	Percival S. Brown.
Sharon,	1,030 79	T. J. Leary.
Sherborn,	564 15	J. P. Dowse.
Shirley,	439 31	John E. L. Hazen.
Shrewsbury,	598 21	Frank L. Ott.
Somerville,	5,000 00	Asa B. Prichard.
Southborough,	706 45	Harry Burnett.
Springfield,	5,000 00	Wm. F. Gale.
Stoneham,	2,010 93	George M. Jefts.
Stoughton,	1,402 83	Wm. P. Kennedy.
Stow,	357 22	J. Frank Robbins.
Sudbury,	497 76	Wm. E. Baldwin.
Sutton,	492 79	John E. Gifford.
Swampscott,	3,997 06	L. Herbert Cahoon.
Taunton,	5,000 00	Alvaro Harnden.
Templeton,	637 93	John B. Wheeler.
Tewksbury,	458 39	Harry M. Briggs.
Topsfield,	501 98	C. W. Floyd.
Townsend,	460 92	Henry H. Jennerson.
Truro,	150 96	Joseph H. Atwood.
Tyngsborough,	209 87	D. A. Lawrence.
Upton,	441 12	George H. Evans.
Wakefield,	3,441 43	W. W. Whittredge.
Walpole,	1,671 86	Philip R. Allen.
Waltham,	5,000 00	Richard A. Jones.
Wareham,	1,508 32	J. J. Walsh.
Warren,	758 74	Alfred A. Warriner.
Watertown,	5,000 00	John C. Ford.
Wayland,	884 84	George W. Fairbank.
Wellesley,	5,000 00	Fletcher M. Abbott.
Wellfleet,	392 38	Freeman A. Snow.
Wenham,	935 63	Jacob D. Barnes.
West Bridgewater,	488 69	Octave Belmore.
West Newbury,	424 49	William Merrill.
Westborough,	1,273 09	William H. Sullivan.
Westford,	700 98	Harry L. Nesmith.
Westminster,	308 50	Stillman Whitney.
Weston,	2,711 61	Edward P. Ripley.
Westwood,	926 67	Fred A. McIlroy.

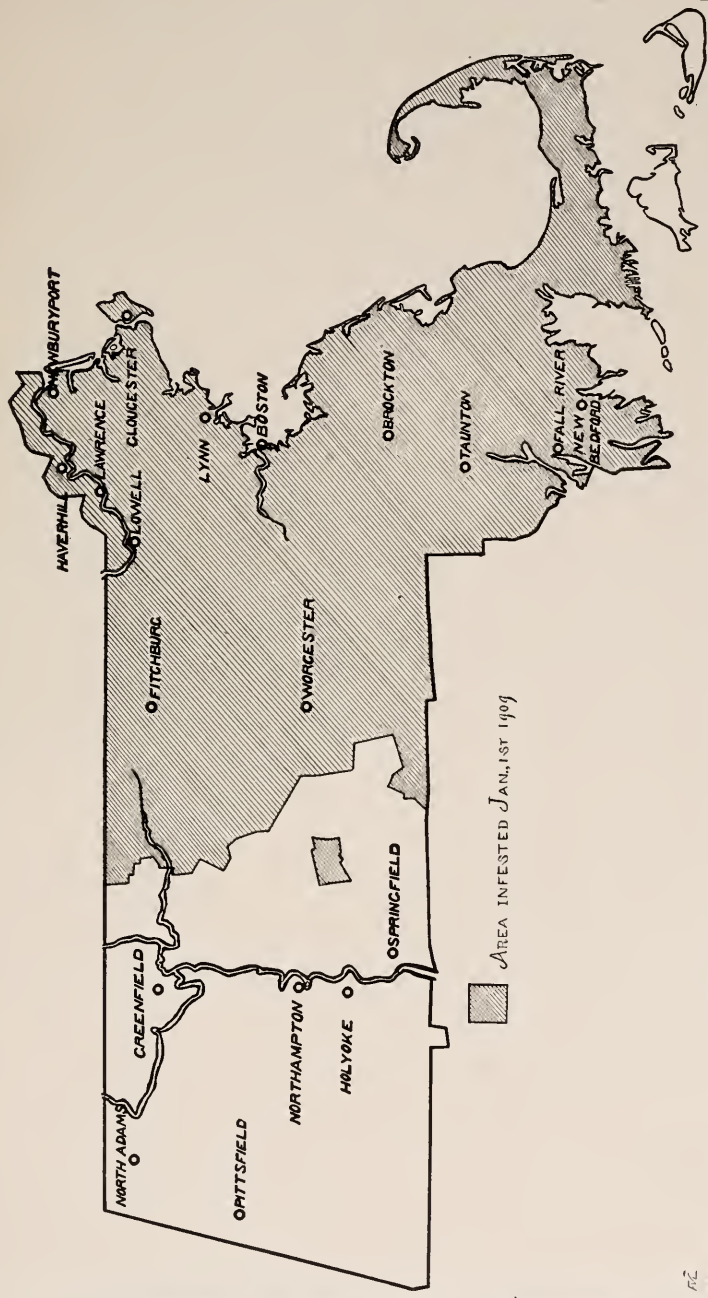
Town or City.	Liability.	Local Superintendent.
Weymouth,	\$3,064 06	Dummer Sewall.
Whitman,	1,896 61	Clarence A. Randall.
Wilmington,	528 36	Oliver McGrane.
Winchester,	4,606 56	Samuel S. Symmes.
Winthrop,	4,303 07	Chas. F. Hilly.
Woburn,	4,476 08	John H. McGann.
Worcester,	5,000 00	J. H. Hemingway.
Wrentham,	476 15	H. A. Cowell.
Yarmouth,	811 96	Charles R. Bassett.

THE BROWN-TAIL MOTH.

In 1907 the brown-tail moth was not as abundant as in previous years, and we did not think it necessary to determine the extent of the infestation, as the possibility of exterminating this moth is very small. The infestation is more serious this year, and it is important that we should know its extent. We therefore employed a few men after the leaves had fallen, to scout the towns on the border of the known infested district. As a result of this scouting the brown-tail moth has been found to extend on the northwest as far as Royalston, on the southwest as far as Southbridge, and in the central part of the State as far west as Ware. The infestation also extends to the extreme end of Cape Cod, to the New Hampshire line and to the coast, making an area in all of 5,147 square miles infested by the brown-tail moth.

FUTURE WORK.

In the year 1909 the work should be carried on along practically the same lines as in the past, by creosoting gypsy moth egg clusters, removing brown-tail moth webs and thinning out woodlands in the winter, and by spraying, burlapping and tanglefooting during the caterpillar season. In a large percentage of the severely infested districts the greater part of the work for the coming year will be in woodlands, where it will be necessary to carry on extensive spraying operations. Several large power outfits have been purchased, and it is hoped



MAP SHOWING AREA INFESTED BY BROWN-TAIL MOTH JAN. 1, 1909.

that more will be in the field before the opening of the caterpillar season, thus giving us a better chance to check the moths in these localities. In the generally infested section it will be well to keep a close watch on the woodlands, that the infestation there may not become serious, thus saving the costly work under such conditions, which several of our cities and towns have been obliged to undertake. In the slightly infested localities the work should have extermination in view at all times, and, if possible, all small infestations should be stamped out. It is also very necessary that the snow-line cleaning should be carried on as in the past, as it relieves all engaged in the work of much anxiety, if we are fortunate enough to have a large amount of snow during the winter months. It is also necessary, where funds will permit, to carry on as extensively as possible the tin patching and cementing of cavities in infested orchards, and also the removal of decayed trees. There is no other method of work that will assist us so much in putting our colonies into good condition in the residential sections as this work.

SPECIAL WORK IN PARKS.

During the year 1908, as in 1907, this office has, with the approval of His Excellency the Governor, deemed it wise to give assistance to several municipalities in which were located badly infested parks, and where the cost of clearing would be more of a financial burden than the city or town could stand. The following places were given consideration: Pine Banks Park, Malden and Melrose; Prospect Hill Park, Waltham; Lynn Woods, city of Lynn; Shaker Glen, Woburn; Mt. Ann Park, Gloucester.

In Pine Banks Park it was necessary to do a considerable amount of thinning, and the greater part of the egg clusters were treated. This was done with the understanding that the trees would be sprayed by the cities of Malden and Melrose, but when the time arrived it was impossible to get them to do this work. We were fortunate enough, however, to have the assistance of the United States government, and the larger part of the park was sprayed by them. During the fall more thinning was done, and the park at the present time is

in better condition than it has been since the work started. If it is properly sprayed the coming season there will be no danger whatever of defoliation there.

In Prospect Hill Park the infestation was very serious, and it seemed that unless a large amount of work was done there the larger part of it was destined to be defoliated. As the condition of Waltham proper was very bad, and as so much work was necessary, it became evident that the city authorities would not be in a position to care for it; therefore, with the approval of His Excellency the Governor, this work was given to a responsible contractor who was the lowest bidder. Thinning operations were carried on over the entire area, and some protective belts were made where there was great danger of the caterpillars migrating from adjoining properties. These protective belts were tanglefooted, and when the foliage appeared, the entire park and a protective border, containing about 200 acres, were sprayed with arsenate of lead. Very good results were obtained, and if the park is properly cared for this winter, next season it should be in very good condition.

In Lynn Woods work was carried on somewhat extensively from the early spring through a part of the caterpillar season. Thinning out of trees was done, roadsides were protected in most cases, and where white pine was abundant the deciduous growth was removed and the pines tanglefooted. Some portions of the park were burned over during the caterpillar season, thus checking the insects to a great extent. This park must be given very careful attention in the future, so that it may not be seriously damaged by the ravages of the gypsy moth caterpillars. To care for this area of 1,000 acres properly is a hard problem, as it means a large expenditure of money, and it must be most systematically done in order that good results may be obtained. The sections of the city of Lynn bordering on this park suffer constantly from reinfestation from this source.

Shaker Glen is not a public park, but is owned by private individuals and much frequented by the public. Inasmuch as it was seriously infested, it was deemed advisable last year to start thinning operations, treat the egg clusters and put it in condition for spraying. Later in the season, as the caterpillars hatched, a



OAK TREE IN DRACUT STRIPPED BY BROWN-TAIL CATER-
PILLARS, JUNE, 1908.

great portion of it was sprayed, and at the present time it is in very good condition, although some work on its borders should be done. We hope to do this protective work during the winter.

Mt. Ann Park, Gloucester, was found to be in a serious condition, and we were called upon by the board of trustees to assist them in the work of cleaning the same. After making a slight inspection of the park it was found necessary to do some thinning, and the whole area, consisting of some 50 acres, was scouted very thoroughly, the gypsy moth egg clusters being treated as found. During the caterpillar season some bur-lapping was done in the worst infested parts. The coming season it will be necessary to thin about half of the area and do thorough work later on. The next caterpillar season it should be thoroughly sprayed. The borders of this park are also in very bad condition, and it will be necessary to use some protective measures to combat the moths.

CONDITION OF INFESTED DISTRICT.

In former reports submitted by this office the condition of each town infested by the gypsy moth has been briefly summarized, but as the towns doing work against the gypsy and brown-tail moths have greatly increased in number, we feel that a general summary of the territory will give all the information necessary.

A noticeable gain has been made the past season, especially in the residential sections, where great efforts have been made, as it is from such sections that the danger of distribution comes. As there are about 10,000 miles of streets whose borders are more or less infested by the gypsy moth, to care for them alone requires a large expenditure of money. Practically the whole of this mileage of streets receives inspection by the trained employees of this office, that extra precaution may be taken against the spreading of the moths. The work now done on private estates by cities and towns is of a better quality than in past years, assuring the property owners satisfaction in the work and security from annoyance during the caterpillar season. Property owners seem also more willing this year to pay the moth tax that the law allows the cities and towns to collect, thus showing appreciation of the fact that the work

has been well done. The possibility of the caterpillars migrating from private estates is also eliminated to a great extent. In many of the cities and towns work has been done in the most important woodland colonies, especially those bordering on residential sections, in order that reinfestation of cleaned estates shall not occur, and the results of previous work thus be lost. In some of the farming sections, where the gypsy moth infestation is serious, the work is greatly handicapped by the large numbers of worthless apple trees, which should be removed or in which the cavities should be filled up, in order that good results may be obtained. These conditions require a large expenditure of money, and exist in towns of low valuation, where the liability is small, thus necessitating that the State provide a large part of the funds for the work to be done. It consequently results that our appropriation will allow us to do but a limited amount of this work each year. It is hoped that the property owners in sections where these conditions exist will co-operate as much as possible with the local authorities, and that they will follow our suggestion, — that a few good trees are better than a large number of poor ones. If the owners will act on this suggestion and give such assistance as they can, a great deal more spraying can be done, the quality of the fruit will be better, and in time the farmers will profit financially. In other localities there are immense tracts of woodland, which handicap both the State and the town in making the necessary progress; and in such places the only practical work to be done is to make protective belts, so that the caterpillars will not migrate to adjoining property now under control and increase the infested area. Large tracts of white pine growth can be handled very easily by removing the deciduous trees and banding the pines with tanglefoot. This treatment has been thoroughly investigated, and is believed to be perfectly safe.

The gypsy moth infestation over the entire State may be divided into three distinct classes: viz., severe, general, and slight. In the severely infested section a large expenditure of money has been made, as it was necessary that thorough work should be done in order to control the spread of the gypsy moth. In this section are comprised some of the wealthiest towns in the



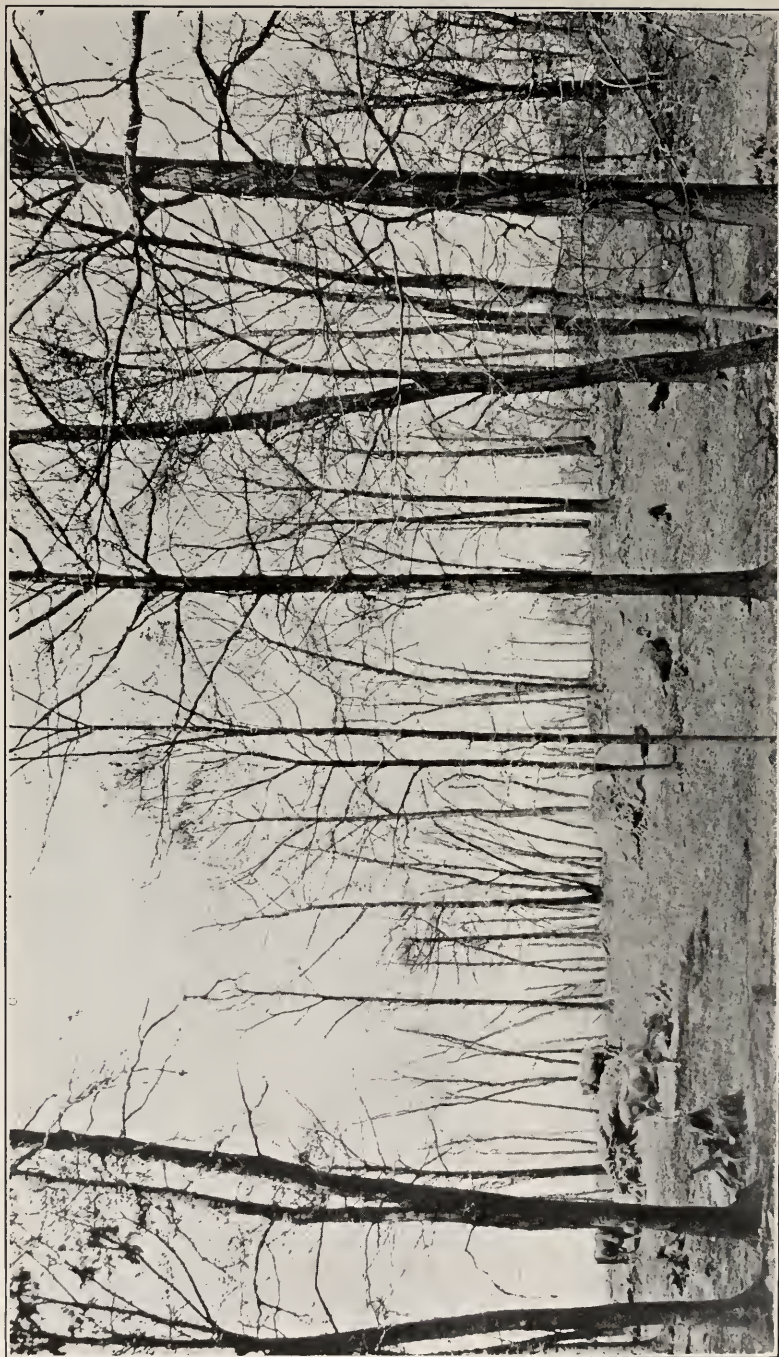
ORCHARD ON SHAW ESTATE, CORNER OF ANDOVER STREET AND BALD PATE ROAD, GEORGETOWN, CONTAIN-
ING 169 FRUIT TREES STRIPPED BY BROWN-TAIL CATERPILLARS, JUNE 12, 1908.

State, and the question of dealing with the gypsy moth promises to be one of the most important problems for these towns in the future. If sufficient funds are not made available for moth work the coming year, great damage will occur in a number of places and the beauty of many large estates will be seriously impaired. During the past caterpillar season Brookline, Newton, Waltham and Georgetown suffered to a considerable extent from stripping in both the residential and woodland sections. At this writing Brookline and Newton are showing more interest than formerly, and seem to appreciate the danger before them. They are now pushing the work more vigorously than ever before. In Waltham, unless more efficient and extensive work is done, severe damage and much annoyance from the caterpillars will be experienced next season. In Georgetown the brown-tail moth caused serious damage in several large orchards. The gypsy moth infestation also is of such a kind that more care must be exercised in the coming season to avert serious damage in many places. The liability of the towns in this class and the allotments which the State is able to make will not be sufficient to check the moths, and some co-operative measures must be adopted to continue the necessary fight, and put the colonies in a proper condition to be handled economically in the future. Many owners of estates are expending large sums of money in ridding their property of the pests, and they should receive some protection. Where they are surrounded by woodland, this protective measure would necessitate the expenditure of large sums of money, so it will readily be seen that other resources than the State and town will have to be drawn upon in such places. In several localities where the infestation is very bad, citizens are purchasing large spraying outfits for their own use, and in some cases loaning them to the local authorities. Other cities and towns are electing committees to act with the local superintendent of moth work in raising funds from individuals to be expended under the direction of the local authorities, and in other places the members of improvement societies are leaving their estates in the hands of the local authorities, agreeing to pay the whole expense incurred on their estates for the year. It is often of value for the local authorities to interview property owners who

have large holdings, and ask their co-operation, thus increasing the amount of money with which to work. Some of the municipalities that are severely infested are not fortunate enough to have wealthy land owners, and here the burden of the expense falls almost entirely upon the city or town and the State, and only a limited amount of work can be done each year, and only the most important sections can receive treatment. The work now needed most is in the woodlands in towns of low valuation, where but a very small amount can be charged to the owner. In several places the owners of large tracts of timber land are awakening to the danger which confronts them, and are clearing their lands, that they may derive what revenue they can from the timber before it is too late.

In the generally infested sections excellent results are being accomplished, and the cities and towns in this class seem to realize that the work must be prosecuted vigorously, in order that they may not become seriously infested. The residential sections are receiving very thorough treatment each year, and the woodlands are being scouted to protect them from serious colonies. This is somewhat expensive treatment, but it is best in the end. We can safely say that the generally infested cities and towns are making headway in their fight against the gypsy moths, and that no serious damage has as yet developed. Extra precaution is taken during the caterpillar season by tangle-footing and burlapping the trees, and spraying in the worst-infested places. The burlaps are watched during the summer season, and the number of caterpillars have been decreased. Some property owners in the generally infested towns are having their woodlands thinned so that they can be cared for economically, and also so that the remaining trees may have a better chance to grow. In some localities, where roadside thinning was thought advisable, it was opposed on the ground that the natural beauty of the roads would be destroyed. However, when it was found that only a short time was required for a new growth of shrubbery, this opposition was withdrawn. In several woodland colonies, where thinning was necessary, there was opposition on the part of the owner; but after the work was performed, and the thinning was found to be done scientifically, the work obtained approval. Many of the cities and towns that are generally in-





WOODLAND STRIPPED BY GYPSY MOTH CATERPILLARS, NEWTON, JULY, 1908.

festes have the necessary apparatus with which to fight the moths in bad colonies, in this way preventing any serious outbreaks. Within this district there are a great many private parks and beautiful pine groves, and the owners have shown a co-operative spirit and at a great expense given them good care, and thus the danger of distribution which exists in such places has been avoided.

In sections where but a slight infestation occurs, exterminative methods are being used, with good results. Most of these infestations are comparatively new, and the local forces have required a large amount of assistance from the trained employees of this office. After the infestations were found by our scouting gangs the city or town officials were notified, and the work was begun at the expense of the town, and in most cases their liability was large enough to cover the same. Very thorough cleaning was done before hatching time in the spring, and followed up during the caterpillar season with burlapping, and in many instances the colonies were exterminated. In other places but few caterpillars were found, and in only a few cases did we find further infestation last fall. In this section the local forces have been very willing to follow our suggestions, and seem anxious to do the best possible work, that they may have good results to show. It is hoped that instead of the infested area increasing in the future by the finding of new colonies, we may be able to reduce it by stamping out slight infestations in the outer towns.

In general, the work has been performed in a very satisfactory manner, and a great gain has been made. In some cases local officials have not realized the importance of the work, and have needed considerable urging. The municipalities where this office has been obliged to take legal measures to enforce the law are very few, and they are being watched closely, to see that their condition does not become such as to prove a menace to neighboring cities and towns. The local forces are improving steadily in the quality of their work, and are making better progress and covering a much larger area than in the past.

WORK OF OTHER STATE BOARDS, ETC.

We wish again to acknowledge the help given in our work by other State boards and commissions, by State institutions and private corporations.

Particularly effective and helpful has been the work of the Metropolitan Park Commission, Massachusetts Highway Commission, Metropolitan Water and Sewerage Board, Massachusetts Board of Insanity, Massachusetts School for Feeble-minded, and the McLean Asylum. We append herewith reports from some of these boards.

METROPOLITAN PARK COMMISSION,
CONGREGATIONAL HOUSE, 14 BEACON STREET, BOSTON, Jan. 16, 1909.

Mr. L. H. WORTHLEY, *Acting Superintendent, 6 Beacon Street, Boston, Mass.*

DEAR SIR:—The Metropolitan Park Commission has no special report to make in regard to the work against gypsy and brown-tail moths in 1908. The work has proceeded upon the same general lines as in previous years, and has proved very successful. Spraying by large power machines was tried over considerable areas, with very good results. The work now seems to have advanced to a point where spraying can be relied upon to a much larger extent than heretofore. A consequent reduction in expense over the same areas may be expected. The general expense, however, will not be reduced, because of the increase along the outside lands on the southerly borders of Blue Hills, and because of the sudden coming back of the brown-tail moths and the invasion of elm-tree beetles. The general condition of the work, however, is satisfactory, and an advance over previous years.

Very truly yours,

W. B. DE LAS CASAS,
Chairman.

Work done on State Highways.

As in the year 1907, we were again requested by the Massachusetts Highway Commission to take full charge of the work during the year 1908. The work was carried on along practically the same lines, and a considerable amount of thinning was done. As the spring opened, it became apparent that extensive spraying operations would be necessary to keep the gypsy moth in check, and also prevent damage from the elm-leaf beetle, an insect pest which was very prevalent during the summer months. Nearly all sections of the State highway



FRUIT TREES KILLED BY THE GYPSY MOTH, WALTHAM, JULY, 1908.

along which thinning of trees and cleaning operations had been carried on previously were thoroughly sprayed with arsenate of lead, with satisfactory results. In some sections it was necessary to burlap the trees to the extent which our funds would permit, in order to destroy the caterpillars which swarmed in from adjoining infested localities. It has been our aim to make protective belts where serious infestations bordered on the State highway, that the roadsides might not become reinfested after being thoroughly cleaned. In the Cape Cod district, where but few gypsy moths were found, spraying operations for the elm-leaf beetle were carried on extensively. In the fall months the sprout growth which had sprung up in places where the trees had been previously thinned was cut over, and after the leaves had fallen, the work of clearing the trees of egg clusters and nests was begun. At this writing nearly all of this work has been completed, and our fall inspection shows a marked improvement along roads. Nearly all the work on the State highway has been done by the local gypsy moth forces of the various cities and towns, as we are assured that these trained bands of men have now reached a high degree of efficiency. In some places, however, it was necessary to employ responsible contractors for certain emergency work in connection with the insect pests. In some cases, where thinning operations on the State highway were necessary, we have been fortunate enough to obtain the services of the United States Department of Agriculture, thus receiving valuable assistance without cost. We feel that it will be necessary for this work to be continued, as in some cases the trees along the highway are liable to reinfestation from various causes, and we shall keep them continually under surveillance. All told, there was expended in this work up to Dec. 1, 1908, \$6,584.25. Work has been done on the State highway trees in the following cities and towns: —

Aetou.	Beverly.	Cohasset.
Amesbury.	Bourne.	Concord.
Andover.	Boxborough.	Dennis.
Ashland.	Brewster.	Dover.
Barnstable.	Chatham.	Draeut.
Bedford.	Chelmsford.	Duxbury.

Falmouth.	Needham.	Tewksbury.
Framingham.	Newbury.	Townsend.
Gloucester.	Newburyport.	Truro.
Groton.	North Andover.	Watertown.
Groveland.	Northborough.	Wayland.
Hamilton.	Orleans.	Wellesley.
Harvard.	Quincy.	Wellfleet.
Hingham.	Reading.	Wenham.
Hudson.	Rockland.	West Newbury.
Ipswich.	Rowley.	Westborough.
Leominster.	Salisbury.	Westford.
Littleton.	Sandwich.	Weston.
Marlborough.	Scituate.	Weymouth.
Melrose.	Southborough.	Winchester.
Merrimac.	Stoneham.	Yarmouth.
Methuen.	Sudbury.	
Natick.	Swampscott.	

METROPOLITAN WATER AND SEWERAGE BOARD,
BOSTON, Jan. 25, 1909.

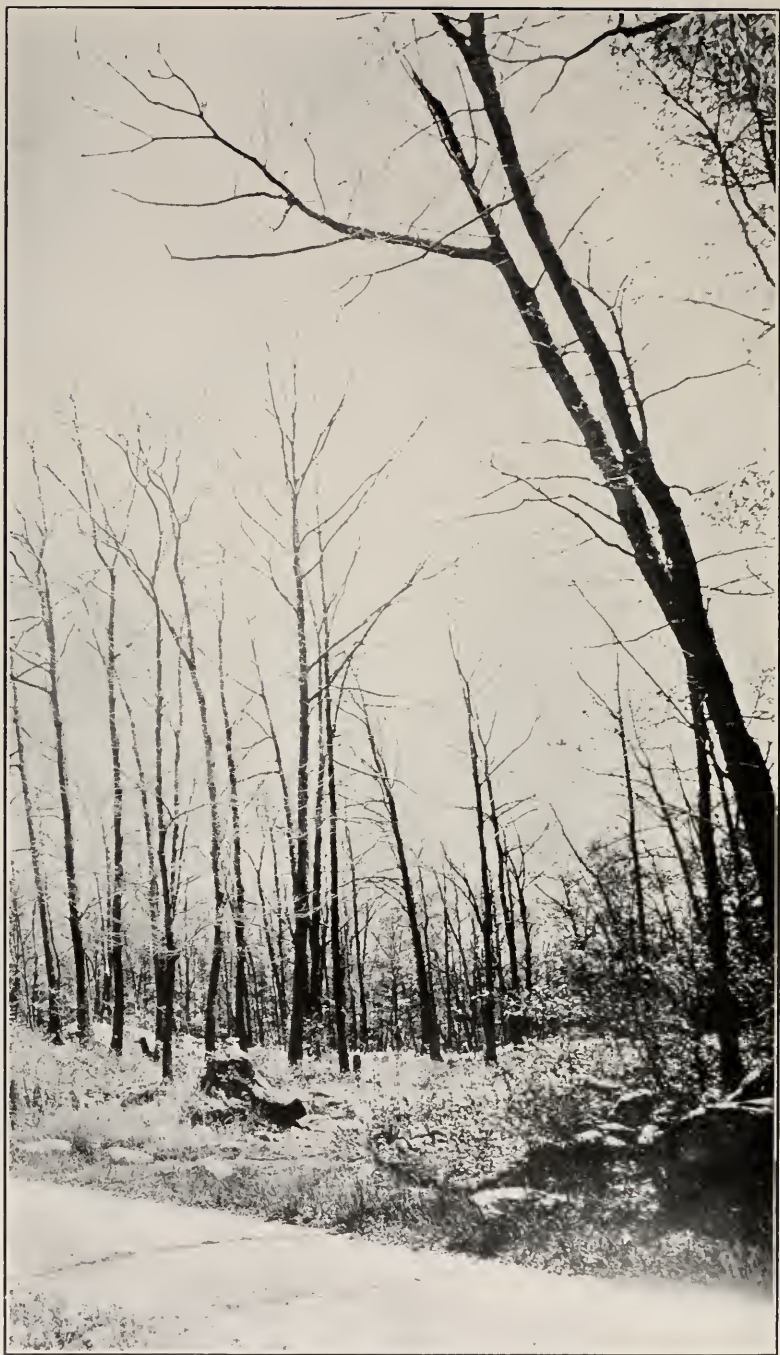
LEON H. WORTHLEY, Esq., *Acting Superintendent.*

DEAR SIR:— In reply to your request that our Board should furnish you with a brief statement of its work against the gypsy and brown-tail moths and other pests on lands under its supervision during the past year, I submit the following:—

During the year 1908 a sum amounting to about \$7,500 was expended for the purpose of protecting trees on the lands of the metropolitan water works from injury by the gypsy and brown-tail moths, the elm beetles and the pine tree weevils. This sum was about \$3,200 less than was expended during the previous year, as the thorough work done on the property at Spot Pond during the past few years has materially reduced the cost of keeping the gypsy moths under control.

The methods followed have been the same as in previous years, namely: painting the egg clusters of the gypsy moths with a mixture of creosote and fuel oil; cutting off and burning the nests of the brown-tail moths; banding the trees with tanglefoot early in the spring, to prevent the caterpillars from ascending the trees; spraying with arsenate of lead all trees which were found to be infested with moths; and banding with burlap the trees in places where moths were known or suspected to be present, and destroying the full-grown caterpillars which collected under the burlap. Trees infested with elm beetles were sprayed with arsenate of lead, and the trees were scraped from the ground to a height of 8 or 10 feet.

The numbers of the gypsy moths have decreased, but the brown-tail moths and the elm beetles have increased in large numbers, as compared with the previous year. Gypsy moths have, however, been found in



WOODLAND STRIPPED BY GYPSY MOTH CATERPILLARS
BROOKLINE, JULY, 1908.

Framingham at points farther west than before. No gypsy moths have as yet been discovered on the water works property around the Wachusett reservoir, but the number of brown-tail moths has increased in the vicinity of the Wachusett dam, and a few have been destroyed in West Boylston at the upper end of the reservoir.

The young pine trees on lands around the Wachusett and Sudbury reservoirs, of which about 1,000,000 have been planted during the past six years, were in the middle of the summer found to be infested with the pine tree weevil, which cuts off the young shoot, generally the leader at the top of the tree. The weevils were destroyed by cutting off and burning the affected shoots.

The work of cutting underbrush and undesirable trees which afford lodging places for the moths has been continued during the year.

The work of protecting the trees has been, as in previous years, carried on under the supervision of Mr. Dexter Brackett, the chief engineer of the metropolitan water works.

Yours very truly,

HENRY H. SPRAGUE,
Chairman.

NATIONAL AID.

The work done this year by the United States Department of Agriculture has been most commendable, and the results obtained in the work of preventing the spread of the moths have been gratifying and helpful to this office. The method used by this department is very thorough, and as a rule the work has been done where it would have been impossible for the State or the infested municipalities to have undertaken it. The work has been principally along well-travelled thoroughfares bordered by woodland. It is very evident that the Commonwealth would have suffered much more than it has from the spreading of the moths if the roadsides had not been cleared by the work of the Department of Agriculture.

In the following report of D. M. Rogers, field agent in charge of the work, a few details of the work will be found. Due credit for this work should be given those instrumental in securing the government appropriations.

REPORT OF SPECIAL FIELD AGENT D. M. ROGERS, UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF ENTOMOLOGY, WASHINGTON, D. C.

Our work during the year 1908 towards preventing the spread of the moths has been very similar to that done in previous years. We have continued work along the woodland roadsides where most infested with

the gypsy moths; we have cleared the ground of underbrush and undesirable trees; pruned the trees; creosoted the gypsy moth egg clusters; cut and burned the brown-tail webs; burlapped, tanglefooted and sprayed strips 100 feet wide in 30 cities and towns, as follows: —

Bedford.	Lynnfield.	Salem.
Belmont.	Malden.	Saugus.
Billerica.	Melrose.	Stoneham.
Burlington.	Natick.	Swampscott.
Concord.	Needham.	Wakefield.
Dedham.	Newton.	Waltham.
Gloucester.	North Reading.	Wayland.
Lexington.	Peabody.	Weston.
Lincoln.	Quincy.	Wilmington.
Lynn.	Reading.	Woburn.

We have now about 230 miles of these roadside strips being cared for, doing practically all of the work against the moths on them. In the last calendar year our Massachusetts force has varied in number from 105 men in August to 242 men in December.

RESOLUTION ADOPTED BY THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

At the twenty-first annual meeting of the American Association of Economic Entomologists, held Dec. 29, 1908, at Baltimore, Md., the following resolution was adopted: —

Resolved, That we again place on record our conviction that the control of the gypsy moth in New England is an entomological problem of the first magnitude, and of great practical importance to the entire country. Furthermore, we would emphasize the necessity of the State of Massachusetts continuing with undiminished vigor the policy prosecuted so ably during the past few years.

Adopted Dec. 29, 1908. Signed by the committee on resolutions: E. P. Felt, F. L. Washburn and R. I. Smith.

SPRAYING OPERATIONS.

It has been fully proved that in the work of combating injurious leaf-eating insects the use of arsenical poisons is one of the most effective methods, provided it is applied at the proper time, and weather conditions are suitable. The use of arsenate of lead in the fight against the gypsy and brown-tail moths has been very helpful, and especially during the last season, as it was



HIGH-POWER SPRAYER IN OPERATION IN WOODLANDS.

very dry and possible to spray nearly every day during the caterpillar season. In purchasing arsenate of lead, care should be taken to buy from reliable dealers who are willing to guarantee their goods.

The improvement in spraying apparatus has been very noticeable, and better results have been obtained at a much less cost than heretofore. It has been the experience of this office that in woodland spraying it is necessary that the engine be at least 7 horse power, and that the pump deliver not less than 35 gallons per minute at 225 pounds pressure, thus allowing long lines of hose to be run from the machine, at the same time maintaining sufficient pressure at the nozzle. In woodland spraying it is advisable to move the machine as little as possible, and to keep it near the water supply. This may be done by using plenty of hose, and it lessens the expense of spraying. At the present time there are several good power outfits on the market that are suitable for doing woodland, street or orchard work. They vary in price from \$700 to \$1,000, and a large area can be covered in a day by any one of them. The average 7 to 10 horse power sprayer, under ordinary conditions, should cover at least 12 acres of woodland per day. In purchasing these machines they should be looked over very carefully, so that when delivery is made there will be no disappointment in the machine; and when starting the machine in operation in the field a competent engineer should be secured, who understands gasoline engines, as delays in the field, with the gang of men ordinarily used on large machines, are very expensive. Arrangements should be made when purchasing a machine to have the necessary assistance in starting the same. Great care should also be used in filling the tanks to see that no foreign matter is pumped up from the brooks or ponds, which may injure the pump. This may be avoided by having a box made 18 inches square and 30 inches deep, to be placed in the water supply. Bore holes in the box, and cover them with wire gauze on both sides and bottom. Under ordinary conditions, this box will allow enough water to flow in to supply the pump. Good judgment should be used in apportioning the amount of arsenate of lead, because at times, especially in the early spring, 10 pounds to 100 gallons of water will accomplish as good results as 15 pounds, and if the larger

quantity is used it is simply a waste of money. There is no method used in fighting the moths where money can be wasted as easily as in spraying, especially with large machines, if care and judgment are not used. Care should be taken to order the necessary supplies for spraying before the season opens, so that when the foliage appears the machine can be put in operation in the field at once. Of course it is a well-known fact that early spraying, as soon as the foliage is large enough to hold the spray, is sure to be the most effective, as the caterpillars are then small and most susceptible to the poison. In several towns where the infestation warranted the use of a large machine it was somewhat doubtful whether such a machine could be used, on account of its weight. We have had several cases cited where it was impossible for two horses to draw the machine when loaded. The large area covered by these machines must be taken into consideration, and if an extra pair of horses should be used half the time during the spraying season, the additional cost would not amount to more than \$75. It may also be expensive to get water if the town does not have hydrant service; but this is very easily overcome by the man in charge exercising good judgment, and building his roads so that he may locate the machine as often as possible near water supplies.

Another important matter to consider in using large apparatus is the hose. Where long lines are used it necessarily involves considerable expense, and proper care should be taken of the hose, in order that it may last as long as possible. It has been our experience that woven marline-covered hose is more economical than ordinary rubber or cotton hose, as it does not kink easily, thus avoiding breaks. It is also necessary that long-tailed two-bead couplings be used, so that they will not blow out under high pressure. Where woodland spraying is to be done, it is economy to purchase 1,000 feet of lead hose and 100 feet of suction hose. Brass fire nozzles with extra interchangeable tips, one $\frac{1}{4}$ inch and one $\frac{3}{16}$ inch, are generally used.

A greater number of power sprayers will be in operation in the field the coming season than the past. In all probability there will be fifty new large machines engaged in the work, and with the good work accomplished by this new apparatus it is believed that better results will be obtained, and next fall,

when the egg clusters are laid, they will be very few as compared with last season. We have several trained men accustomed to using power sprayers, and it is our intention to give all the assistance possible to the several cities and towns which have not had experience in the use of them. If the start is made in the right direction, much better results will be obtained.

It must also be taken into consideration that in cities and towns where small infestations occur, good results may be obtained by hand-spraying outfits. These outfits can be purchased at very moderate prices. One large enough to care for a few infestations costs approximately \$27. This includes everything but hose. The next larger size, at \$45, will give much better results in proportion to the cost. It must be remembered that only a few years ago hand outfits did the major part of the spraying against leaf-eating insects. Persons owning large orchards in towns infested by the gypsy and brown-tail moths obtain excellent results by spraying their fruit trees with arsenate of lead, using the small outfit, and this work has been greatly appreciated by those engaged in the work against the moths. In some of the smaller towns, having scattered infestations, small outfits were purchased by the towns, and citizens allowed to use them, furnishing their own poison. This has proved to be a great help both to the town and this office, and more of this work might be done to good advantage.

NORTH SHORE WORK.

In 1907 the work of making a thorough inspection of the north shore woodlands was begun, and continued through the winter and spring into 1908. The block of woodland under consideration lies in the cities of Beverly and Gloucester, and the towns of Wenham, Hamilton, Essex and Manchester. When this work was finished, in March, a statement of the infestations located was drawn up and submitted to Col. W. D. Sohier, Beverly, Mass., who represented the residents of the north shore district. From him we received assurances that if a general effort to control the gypsy moth throughout this entire block of woodland, without reference to town boundaries, could be made, a substantial contribution from the property owners in that district would be forthcoming. After several confer-

ences, with the approval of His Excellency the Governor, an agreement was made whereby this office, from its appropriation, the town of Manchester and the city of Beverly and the north shore residents, would all contribute to a fund to be deposited with the Honorable State Treasurer. It was also arranged that the expenditure from this fund for the purpose of suppressing the gypsy moth in the north shore woods should be under the direct supervision of this office. The total amount thus expended, and the sources from which it was obtained, are given in a financial statement on another page. This arrangement seemed most desirable, for many reasons. There is no more valuable area of woodland in the entire State or in New England than that which lies between Beverly and Gloucester. Here large sums of money — often running into the thousands on a single estate — have been annually expended by property owners to protect their trees from the moths. As long as adjoining woodland areas were not freed from the moths, the work of such public-spirited citizens was annually undone by caterpillars swarming in from without. Again, the residents of this section have built many miles of excellent wood roads for carriage driving, and thrown them open to the public. This section being so much frequented for shore driving, the danger here of spreading the moths through the dropping of caterpillars on vehicles is particularly great. Furthermore, it seemed particularly to the advantage of this office to cooperate liberally with these municipalities and citizens, when they were in the mood to make large contributions for the purpose of controlling the moths.

We treated the scattering infestations and began thinning operations in the woodlands on March 19, with 25 men, gradually increasing this number, until on May 10, 420 men were employed in the work. About 20 bad colonies had been located by the scouts where thinning operations were necessary, covering an area of approximately 1,100 acres. These colonies were freed from underbrush and dead trees, leaving the greater part of the conifers standing. Some gypsy moth egg clusters were treated in the worst infestations, and dead wood removed from trees where it seemed necessary. As soon as the foliage appeared, the thinning of woodlands was gradually stopped, since

it was apparent that a larger area had been opened up for spraying than could be taken care of by the sprayers before the height of the caterpillar season. It was evident at the start that the principal reliance in treating these woodlands must be placed upon spraying operations; therefore, four power sprayers of the largest type were ordered early in the season, and were delivered and in operation during the week of May 17. In order to reach the most important colonies, and to make use of brooks, ponds or hydrants for water supply, it was necessary to construct more than 9 miles of wood roads. Many miles more would have been necessary if it had not been for the fact that with the high-power sprayers long lines of hose (1,000 to 1,500 feet) could be used with good results. At the same time, locations where water could be secured were taken into consideration. These roads are of permanent value for spraying operations at any time in the future.

Owing to the lateness of the season when this work began, and because of the millions of egg clusters present in the infested woods, considerable stripping occurred in the center of the worst colonies, and the insects migrated towards the borders of these colonies. This of course necessitated spraying the borders of the colonies, in order to destroy the migrating caterpillars. In nearly all places treated good results were obtained, and these colonies can be treated the coming year at a much less expense. If the necessary funds are made available the coming season, the woodland in which work has been done should come through the caterpillar season practically unharmed. At the close of the spraying season the force was reduced to a very small number of men. Some of them were engaged in putting the machines in order that they might be in good condition for the next spraying season, while the others were engaged in locating colonies which had become established in localities where we were unable to do any scouting. The development of this work showed that a second area as large as that first scouted was badly infested, and that it would be necessary to take up work along the same lines in this new section the coming season. After the caterpillar season the few men retained were engaged in creosoting egg clusters in some of the worst colonies.

The latter part of October a report of our work was submitted to Col. W. D. Sohier, and a further plan of co-operation, with the approval of His Excellency the Governor, was arranged between the residents of the north shore and the Commonwealth, and in the middle of December a force of about 60 men started thinning operations. After inspection, it became evident that a large sum of money would be necessary to continue this work. If the necessary amount cannot be made available, the woodland mentioned above as cleared and sprayed last year will suffer greatly, as well as the residential section in the district; and it is hoped that hearty co-operation can be obtained through the same channels as last year. We submit below a financial statement:—

SPECIAL NORTH SHORE FUND.

Dr.

1908.

April	3.	To Wm. D. Sohier, agent, . . .	\$2,000 00
"	7.	To city of Beverly, . . .	5,000 00
"	10.	To A. H. Kirkland, superintendent, . . .	10,000 00
"	15.	To Wm. D. Sohier, agent, . . .	3,000 00
"	25.	To Wm. D. Sohier, agent, . . .	5,000 00
"	26.	To town of Manchester, . . .	2,000 00
May	19.	To town of Manchester, . . .	3,000 00
June	3.	To Wm. D. Sohier, agent, . . .	5,000 00
"	11.	To A. H. Kirkland, superintendent, . . .	5,000 00
"	26.	To Wm. D. Sohier, agent, . . .	2,000 00
July	7.	To Wm. D. Sohier, agent, . . .	3,000 00
"	9.	To A. H. Kirkland, superintendent, . . .	5,000 00
			<hr/> \$50,000 00

Cr.

By expenditures:—

Wages of employees,	.	.	.	.	.	\$38,393 60	
Travelling expenses,	.	.	.	.	.	250 38	
Rent,	.	.	.	.	.	60 00	
Supplies,	.	.	.	.	.	10,900 88	
Sundries,	.	.	.	.	.	324 90	
							49,929 76
Balance Nov. 30, 1908,	.	.	.	.	.		\$70 24



PIERCE'S PINES, ARLINGTON, SHOWING RESULTS OF USE OF TANGLEFOOT ON WHITE PINE.

THE GYPSY MOTH *v.* WHITE PINE.

In the last report of this department (page 163) this subject was discussed in a conservative manner, and details were given of a certain number of experiments with young gypsy moth caterpillars on white pine foliage, tending to show that in the early stages of their existence these insects could not live on white pine alone. Because of the importance of this discovery, if true, Mr. Kirkland preferred to take conservative ground, and await the results of the larger series of experiments in 1908. Fortunately for the thorough testing of the matter, there was found in the fall of 1907, at Arlington, Mass., on the property of Mr. F. A. Pierce, an area of 10 acres of white pine free from deciduous growth which was generally infested by the gypsy moth, some of the trees bearing hundreds of egg clusters. In co-operation with Mr. D. M. Rogers, Field Agent of the United States Department of Agriculture, these trees were banded early in the spring with the sticky preparation known as tanglefoot. Upon the hatching of the eggs the young caterpillars spun downward in large numbers to the ground, or died in the foliage of the trees. The bands, which were kept fresh for a period of about ten days, prevented their ascent, and, although the tree tops were literally full of the young insects, not a single pine was defoliated, and at the time of the fall inspection only 14 new egg clusters could be found in the entire area. The accompanying photographs, taken at the height of the caterpillar season, show the effectiveness of this method of treatment. This experiment on a large scale seems to give final and conclusive proof that where the hardwood growth is thoroughly destroyed in a pine forest, there need be no fear from damage by the gypsy moth caterpillars, provided the trees are properly protected from invasion from without by the use of sticky bands.

At Beverly, Mass., in the center of a large wooded area, about 3 acres of large white pines were found badly infested by the gypsy moth during the winter of 1907-08. Here all hardwood growth and brush were removed, and a limited protective belt cut around the pines. No further care was given to this colony. No egg clusters were treated or spraying done,

yet notwithstanding the fact that in the spring of 1908 many of the large pines were literally yellow in places with the egg clusters, a careful examination in the fall of the year showed that, although the egg clusters had hatched freely, fresh egg clusters were exceedingly rare. There had been a decrease of the insect in this section estimated by Mr. Kirkland and the writer at fully 90 per cent.

Again, in a woodland colony at Marshfield — a generally infested section — all white pine was similarly treated, the hardwood and underbrush being removed, but no effort made to destroy the egg clusters on the pines. This colony received no further care during the summer, yet at the close of the year but three new egg clusters were found.

Considering the results of wholesale field experiments, together with those from the more carefully conducted investigations of the previous year, we are led almost irresistibly to the conclusion that a grove of white pine is absolutely safe from damage by the gypsy moth caterpillars as long as its borders are properly protected from invasion from without. It will be perfectly safe, as far as the gypsy moth is concerned, to make plantings of white pine, provided a belt of at least 200 feet in width is kept clear around the borders of the same. It will also be perfectly safe to leave standing in the moth-infested district blocks of white pine trees, provided all hardwood and underbrush are removed and kept down and the borders similarly protected. This may be done either by cutting clean belts around the blocks of pine, or by banding the trees with sticky materials for a distance, say, of 100 feet around the borders. We believe the results of this investigation to be of the greatest practical importance to those engaged in forestry operations in this State or elsewhere in the gypsy-moth-infested district, since it will permit of the general planting and cultivation of white pine without fear of damage from the moths.

DANGER TO LIVE STOCK.

The experience of the past year substantiates that of 1907, and confirms our opinion that where the solid stream spray from high-power outfits is used there is a certain amount of danger to live stock which may later feed beneath the sprayed

trees. With this system of spraying, which does not involve the climbing of trees, a large percentage of the poison falls to the ground. With the mist spray, used in connection with low-power outfits, where the trees are climbed and carefully sprayed by hand, but little of the poison falls to the ground, and there is practically no danger to live stock, other than poultry, which may feed under the trees. Since the wholesale spraying operations against the gypsy moth, particularly in woodlands and along roadsides, involve the use of high-power sprayers throwing a solid stream, much greater care must be taken in the future than in the past, to prevent the poisoning of live stock. We recommend that wherever spraying of this kind is done along roadsides, in pastures or in woodlands, suitable placards should be displayed, indicating that the trees have been sprayed and that it is dangerous for stock to be allowed to feed beneath them. The owners of land thus sprayed should be promptly notified. We think it also desirable, as far as possible, to fence off the sprayed sections from the unsprayed, as in the case of pastures, making such arrangements with the owners as may be necessary.

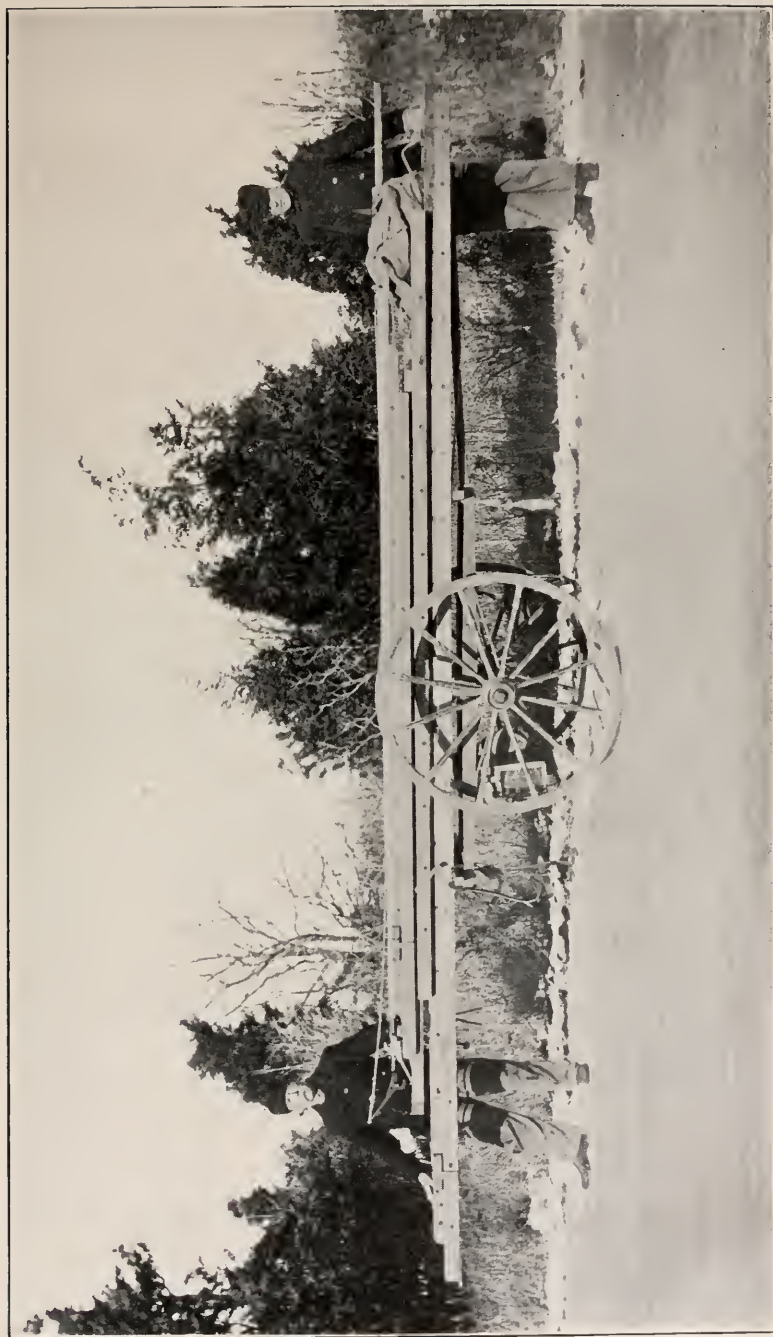
In the case of the alleged death of live stock from spraying operations, it is important that the viscera should be removed and subjected to chemical analysis, if claim for damages is to be made against the city or town. The Honorable Auditor of the Commonwealth has ruled that claims for loss from the death of live stock alleged to be due to spraying operations, under the direction of this office, are not a proper subject for reimbursement from the appropriations for the suppression of the gypsy and brown-tail moths, but that rather they fall in the class of consequential damages, which must be borne, if at all, by the city or town in which they occur.

PURCHASE OF SUPPLIES.

Further efforts have been made to systematize the purchase of supplies used by the several cities and towns in the work of suppressing the moths. It is of course most unbusinesslike that one town should pay a price greatly in advance of that paid by a neighboring town for the same kind and grade of materials. Last year competitive bids on the principal sup-

plies used in the work were obtained from several dealers, and the lowest responsible bidder was recommended as the source from which goods of certain kinds should be purchased. This year a similar course has been followed on a more extended scale. During the fall months a complete list of all supplies needed in the field work was prepared and widely circulated among reputable dealers, who were invited to submit quotations, with the understanding that the lowest responsible bidder on a given kind of material should be recommended to the several cities and towns. A complete list has been made up from the bids so collected, printed in convenient form for the pocket, and supplied to each local superintendent. We have been able to secure considerable concessions on nearly all the important tools and supplies used in the field work. Thus an important economy has been effected, and the local superintendent has continually at hand the prices of supplies and addresses of dealers from whom such supplies can be obtained. It is urged that cities and towns follow the recommendations made in this list, in order to encourage the dealers to make even greater concessions in the future. The principal cost in the moth work is in the labor item, and every possible economy secured in other lines makes possible the employment of additional labor.

The local superintendent should, when purchasing supplies, keep in mind at all times the importance of buying supplies in as large quantities as he can use, so that the field operations may not suffer from lack of the tools at the right moment. Much better prices can be obtained, also, on larger quantities. In vouchers submitted to this office it has been noted in several cases that axes, bush hooks, etc., have been purchased one at a time. We advise that in most cities and towns at least one-half dozen if not more of such articles should be bought at one time, thus securing a supply on hand and enabling the local superintendent to spend most of his time with his men. We consider it good judgment at the opening of the several seasons to have the necessary supplies on hand to work with. It will be noted in the latest price list that hand carts are quoted. It is hoped that those engaged in the work will appreciate the saving that can be made by using one, thus doing away with the use of a horse and wagon as much as possible. In several



HAND CART RECOMMENDED TO REPLACE HORSE AND WAGON IN FIELD WORK.

cities and towns we believe that teams are being used more than is necessary, and we shall endeavor in the future to reduce this expenditure.

THE WILT DISEASE OF THE GYPSY MOTH.

During the caterpillar season of 1908 we employed experts to investigate the wilt disease of the gypsy moth, looking to the end that this disease, which is probably bacterial, might be propagated and spread artificially. No conclusions definite enough for publication were reached last season. The work will probably be continued in the summer of 1909.

THE FUNGUS DISEASE OF THE BROWN-TAIL MOTH.

The experiments made under the auspices of this office during the past year for the purpose of testing the efficiency of the brown-tail moth fungus (*Entomophthora Aulicæ* Reich.) as a means of producing artificially a wholesale destruction of these insects in badly infested areas, was suggested by the apparent success of a similar experiment made during the previous year at Kittery Point, Me. Early in June, 1907, a large arctian larva was found in this locality, freshly killed by the *Entomophthora*, and as soon as the spore-discharge had commenced, several thousand brown-tail larvæ were placed in such a position that they would be exposed to it. The infected larvæ were then distributed over an area badly infested by brown-tail moths, and allowed to crawl up such trees as were most seriously infested, in order that they might join and mingle with the uninfected larvæ. The period of incubation of this disease is about five or six days, more or less, the time varying with the size of the infected individual, the temperature and the weather conditions; and after this period of incubation within the larva the disease is propagated by an external discharge of minute spores, which, by a special mechanism, are shot violently into the air. A well-grown larva, under favorable conditions, would probably discharge several hundred thousand of these spores, each capable of infecting a fresh larva in case it came in contact with one; and among gregarious insects, like the ones in question, the chances of copious infection are very great.

After a little over two weeks, that is, after time enough had elapsed for two or three generations following the death of the larvæ originally distributed, the locality at Kittery Point was again inspected, and a very general epidemic was found to be in progress. Thousands of the dead and dying larvæ were found on the trunks and branches of the trees, and everywhere that the brown-tails were feeding; and, when, somewhat later, the time for pupation had arrived, it was difficult to find a single healthy larva. It was further noticed that the disease had extended north and east in the path of the winds prevalent at this season, while there appeared to be little if any extension of the disease in the opposite directions.

Although the conditions indicated may well have arisen as the result of natural infection, and may not have been caused, or even greatly influenced, by the distribution of the infected larvæ, the extraordinary efficacy of the disease in clearing this region of the pest was not to be questioned. In view of the unusual susceptibility to the *Entomophthora* contagion shown by the brown-tail caterpillar, and the wide-spread epidemics to which it is subject from this cause, as evidenced by the conditions seen at Kittery Point, as well as in some other localities, it seemed desirable to certain persons interested in the endeavor to control this pest that some attempt should be made to test the efficacy of artificial infections with this fungous disease. By a special arrangement with this office, therefore, Dr. G. P. Clinton, mycologist of the Connecticut Agricultural Experiment Station, was given leave of absence for several months, in order that he might undertake the work. That the results obtained were less definite than had been hoped for was certainly not due to any lack of ability or persistent effort on the part of Dr. Clinton, to whom those especially interested in the experiment are under great obligation for the vigor with which he prosecuted the work, which was not only an interference with his professional duties at the station, but which was also accompanied by an amount of physical discomfort which can only be appreciated by one who has experienced the consequences inevitably associated with continual handling of these stinging caterpillars.

Owing to unavoidable delays in making the necessary ar-

rangements with Dr. Clinton, the work on the brown-tail moth fungus, for which facilities were furnished by the botanic garden and the cryptogamic laboratories of Harvard University, was not commenced until May 14, and material of the fungus itself was not obtained until some days later.

Provision had been made for obtaining material of the fungus for use in artificial infections, by sowing resting spores, by means of which it is carried over in nature from season to season, in a breeding cage at the garden; but before any diseased larvæ appeared in this cage, several were found ready to discharge spores on nests brought into the laboratory. By means of these and others which in a few days began to appear in the garden cage, a sufficient number of infected larvæ was obtained to enable Dr. Clinton to make a first distribution in a badly infested tract at Concord. It was therefore not until May 28 that a first distribution of infected larvæ was possible; but even at this date it had become evident that the chances of a successful termination of the experiment were small, owing to the fact that the hot weather in May had advanced the season, as compared with that of the previous year, nearly two weeks, so that by the first week in June the larvæ were nearly ready to pupate, and a sufficient number of generations of the fungus between the first artificial infection and the period of general pupation was not available; while the drought which began in early June made the conditions as unfavorable as possible for the purpose in view. It was further found that in all the localities which were selected for the distribution of artificially infected caterpillars the disease had begun to appear spontaneously, so that such results as were obtained cannot be definitely attributed to the artificial infections made in these situations.

The mortality observed among the brown-tail moths, though very considerable (estimated by Dr. Clinton as from 10 to 80 per cent. in the various localities examined, with an estimated average of from 30 to 50 per cent.), was checked so abruptly by the dry conditions above mentioned, which began during the second week of June, that many larvæ were found later in the month that had been killed and mummified by the fungus, although, from lack of moisture, no discharge of spores from

them had taken place, — a condition of things quite unusual where well-grown larvæ are concerned.

The results of Dr. Clinton's work have led him to express the opinion, in the report which he has submitted, that the outlook for a practical application of the fungous disease of the brown-tail moth by means of the distribution of infected material is an unfavorable one; but it should be remembered that his work was hampered and its successful accomplishment interfered with, first, by the fact that the work was begun three weeks later than it should have been; that the fungus was not available for use until it had already begun to appear in nature; that, the season being nearly two weeks earlier than on the preceding year, two or three generations of the fungus were eliminated from the experiment; and lastly, that the unusual dryness of the season afforded the most unfavorable conditions possible for the successful issue of the experiment.

Dr. Clinton was assisted in his work by Mr. A. T. Speare, now a graduate student in botany in Harvard University, who has subsequently been employed by this office to keep the fungus in an active condition by continuous propagation during the late summer, fall and winter, so that it may be available for use as early as may be necessary during the coming spring. This object has been successfully accomplished by Mr. Speare, who has the fungus in good condition for propagation in the greenhouses of the botanic garden at the present writing. It will therefore be possible, if it seems desirable to continue the experiment another year, to make the infections two or three weeks earlier than was possible during the past year, and before the fungus would occur in nature.

It may be mentioned further that Mr. Speare, despite the well-remembered drought of last August and September, made a successful attempt to spread the disease among the fall nests in a badly infested locality near Lynn, where he produced a destructive local epidemic not observable in adjacent localities; and it is also of interest to note that he succeeded, later, in finding larvæ containing resting spores in many of the infected nests, — a fact which indicates that under favorable conditions an infection of autumn nests may be depended upon to propagate the disease in the following spring.

In conclusion, the present situation may be briefly stated thus: The fungous disease of the brown-tail moth is undoubtedly the most efficient factor at present working in nature against the ravages of this pest, and under favorable conditions may almost completely eliminate it from considerable areas in a single season. In view of this fact, notwithstanding the unsatisfactory results of the experiments made during the past year, a continuance of the work for another season seems decidedly desirable, for the reason that a second attempt in this direction is not likely to be hampered, as in the first instance, either by lack of material for early infection, or by such delays in beginning the work as were incident to the first attempt; while, if the season proves neither unusually early nor unusually dry, much more favorable results may be anticipated.

THE PARASITE WORK.

The work of importing and colonizing the various foreign insects parasitic or predatory upon the gypsy and brown-tail moths has been continued throughout the year. The material imported, while in actual amount not greatly in excess of that of the previous years since the work was begun, has generally been received in better condition and has been more diverse in character. The actual number of beneficial insects liberated was far in excess of that for 1906 or 1907, and the list includes several of great importance and promise which have never before been received at the laboratory in a living condition, or at all.

This increase is due to several causes. The improved condition of the foreign material on receipt and its greater diversity in character are in part responsible. The laboratory at Melrose Highlands is much better adapted for the work than was that at Saugus; the permanent force at the laboratory has been notably increased; and, more than all, a larger knowledge of the parasites and predators themselves, their habits and requirements, has made possible a much more intelligent handling of the imported material.

Mr. W. F. Fiske, who assumed charge of the laboratory work in 1907, has continued in that position throughout the year, and has been most ably assisted in the actual work of colonization and

in the subsequent work in the colonies by Mr. F. H. Mosher, who has been connected with the laboratory since its inception. Mr. A. F. Burgess, who has been connected with the work against the gypsy moth upon several occasions in the past, was detailed by the Federal Bureau of Entomology to work upon the several species of predaceous beetles; and Mr. C. H. T. Townsend, who has wide experience and national reputation in his particular line, was similarly detailed in charge of the Tachinid parasites.

This division of the laboratory work has made possible a much more thorough investigation into the habits and biology of the insects studied. While this work has of necessity been more or less technical, in part, it has been the aim of those concerned to eliminate all purely technical features, and to confine the investigations to those phases in the life of the insects which were in some way associated with the actual and practical work of importing and liberation under conditions which should be as favorable as could possibly be secured.

Importations have been received from all of the central European countries, as hitherto, and in addition a large amount of material was secured from Japan, through the efforts of Prof. Trevor Kincaid of the University of Washington, Seattle, who spent the entire season in Japan as an agent of the Commonwealth. It was through him that the enormous numbers of cocoons of the Japanese *Glyptapanteles* were received. This insect has long been known as one of the most important of the natural enemies of the gypsy moth in Japan, and each year since the parasite work was begun attempts have been made to secure it; but invariably the parasites have been dead upon receipt, and it became evident that it was necessary to employ especial care in the collection and packing of the material and shipment in cold storage before success could be expected.

This most difficult task was most ably accomplished by Professor Kincaid, who made satisfactory arrangements with the steamship companies, devised a package by the aid of which not only the parasite cocoons themselves, but the young parasitized caterpillars of the gypsy moth itself, were shipped successfully. In addition to this, his industry in collecting the

vast amount of material, in which he was fortunate enough to secure the active co-operation of the native entomologists, is noteworthy.

In addition to the *Glyptapanteles*, which is considered as the most important of the Japanese parasites, several other species, less important according to our present standards, but promising, nevertheless, were received through Professor Kincaid. These include Tachinids of several species, for the most part similar to European forms; several Hymenopterous parasites of the pupæ, and a number of egg parasites, a part of which have since been received in considerable numbers through Japanese entomologists, and are now being held at the laboratory for liberation in the spring.

The work upon predaceous beetles has been in some respects the most satisfactory of any done at the laboratory. In 1906 and again in 1907 considerable numbers of the most promising of these, *Calosoma sycophanta*, were imported as adults, and liberated in several localities in eastern Massachusetts. In 1907 the beetles were found in nearly all of the localities where liberations were made the previous season, and in 1908 they were again found in these colonies, and also in the colonies established in 1907. In most instances they were present in numbers sufficient to denote a most satisfactory rate of increase.

Beginning in the fall of 1907 and continuing through 1908, several other beetles, less promising, but of possible assistance in controlling the gypsy moth, were imported in smaller numbers and studied at the laboratory or liberated directly in the field. A considerable number of adults of the *Calosoma* above mentioned were kept under as natural conditions as possible in the laboratory, and from them a large number of larvæ were reared through their early stages and then liberated in the open. Serious losses, which are likely to occur among the very young larvæ in the field, were thereby avoided, and the increase and rapidity of dissemination of the insect hastened.

So common did this enemy become in certain of the localities where it had been liberated, as to make it advisable during the summer to issue a brief bulletin, illustrating the different stages, as a warning to those engaged in the destruction of the

gypsy caterpillars and pupæ. The full-fed *Calosoma* larvæ frequently take refuge under the burlap bands, and any one ignorant of their nature might inadvertently destroy them.

Although this insect is unlikely ever to increase in numbers sufficient to control the gypsy moth unaided, yet it possesses several most promising characteristics. Its various stages are well represented on Plate 12. The eggs are deposited in the earth near the base of trees infested by the caterpillars, which serve as food for both larvæ and adults. The larvæ as soon as they hatch climb the trees in search of their prey, and even at this stage are strong and active enough to attack the full-grown caterpillars of the gypsy moth. When supplied with an abundance of food they grow rapidly, molting twice, and then enter the earth, where their subsequent transformations to pupæ and adults occur. The adults do not appear to leave the earthen cell in which the final transformation takes place until the following spring, when they come forth, ready and willing to begin their warfare upon the young gypsy caterpillars without delay.

They are known to live for several years, and during their periods of activity, which correspond in a general way to those of the gypsy moth itself, they feed voraciously, and during these periods the females lay in the aggregate a large number of eggs. They appear to seek out and to remain in the vicinity of the more abundant colonies of their preferred food; and the fecundity of the females, and the consequent rate of increase of the species, is to some extent, at least, dependent upon the abundance of the food supply.

The increase and particularly the dissemination of this insect may be hastened materially by artificial means, and during the next few years it is desired to do everything possible which will favor its spread and multiplication. At the very best, however, it will require several years before it is possible for it to demonstrate its value from an economic standpoint, notwithstanding the abundant evidence of its beneficial character already secured.

The Tachinid or Dipterous parasites of the gypsy and brown-tail moths include a large variety of species of more or less promise. Some of these occur so infrequently abroad as to



CALOSOMA SYCOPHANTA BEETLES ATTACKING GYPSY MOTH CATERPILLARS.

make their utility in this country very problematical, but there are a few among them which are of greater promise than any others among the numerous natural enemies which have been studied at the laboratory.

The work done by Mr. Townsend has demonstrated the existence of a very great diversity in the life of these insects during their earliest stages; and the results of this work have served not only to indicate the best methods by which the parasites themselves may be imported and handled after receipt, but have tended strongly to indicate the enormous possibilities for good possessed by certain among them.

Probably the most promising at the present time is one technically known as *Blepharipa scutellata*, a large and strong insect, not unlike the common fly in general appearance. The females of this species deposit several thousands of exceedingly minute eggs upon the foliage of trees near where the caterpillars of the preferred host are feeding. These eggs are eaten by the caterpillars, hatch in the alimentary canal, and the young maggots resulting, establish themselves within the tissues of their host. For a time they feed without causing it apparent inconvenience, but when nearly full fed, which may not be until after the caterpillar has changed to a pupa, they cause its death, feed for a time upon the dead body, and then, dropping to the earth, burrow into it and complete their transformations.

The perfect flies do not emerge until the following spring, and there appears to be but a single annual generation, in which respect the parasite resembles the gypsy moth itself. An insect depositing its eggs upon a leaf, in the chance that this leaf will be eaten by an insect which is capable of nourishing its young, is exposed to a very great liability of loss during its egg stage. This is partially compensated for by the large number of eggs deposited, amounting, as has been stated in this instance, to several thousand, possibly 5,000 or more. It possesses at the same time a potential fecundity far in excess of that of the gypsy moth itself. When practical defoliation occurs, as it frequently does where the caterpillars are numerous, the increase of the parasites ought to be very rapid, and, other conditions being equal, far to outstrip that of the gypsy moth itself.

In spite of the relatively considerable abundance of this in-

sect abroad, and of the fact that it has been received in considerable numbers each year since the work of parasite introduction was begun, it has been found impossible to procure enough healthy adults to form a colony of a size sufficient to form a fair test of its economic value as a parasite. This is due to the great difficulty in keeping the pupæ over winter, under the necessarily artificial conditions accompanying their collection and transportation. The maggots, after their emergence from the caterpillars, normally enter the ground to a considerable depth. Here they should remain undisturbed until their final transformation to the fly in the following spring; and it has been the experience at the laboratory that any disturbance to which they may be subjected during this period is followed by a rate of mortality amounting, in the several years since their introduction has been attempted, to from 90 to 98 per cent. The cause of this appalling death rate is not altogether apparent. It is hoped that it will be materially lessened in the case of the thousand or more pupæ now on hand; but should these hopes prove futile, it will be only a question of time and additional expense before a satisfactory colony of the insect is established.

In 1908 about 100 healthy individuals of this species were liberated near Melrose. The species was not recovered in the considerable collections made in the vicinity of the colony the same season; but the fact was not at all to be wondered at, from the relatively insignificant number of the parasites as compared with the many millions of gypsy moth caterpillars which were present in the area over which the parent flies would be expected to fly. There is, therefore, a possibility that the insect has already gained a foothold in America.

Blepharipa, while possessing more promise than the majority of the numerous species of Tachinids imported or attempted which have been secured in larger or smaller numbers, is only one of several scarcely less promising, and it is hoped that several others will successfully be introduced and acclimated in the course of the coming season. Several of these which have already been imported and colonized have also been recovered from collections made in the field. One of these, *Parexorista chelonix*, while entirely different from *Blepharipa*

in habit during its early stages, is of considerable importance as an enemy of the brown-tail moth abroad, and likely to become so here.

The Hymenopterous parasites of the gypsy and brown-tail moths, while less numerous than the Dipterous, include several very important species very diverse in their habits. These insects are more adaptable to increase in the laboratory than are the Dipterous; and one in particular, which attacks the hibernating brown-tail caterpillars within their nest, has been reared in the laboratory by the hundreds of thousands, and at small expense. There are on hand at the present time, awaiting the proper time for their liberation, in excess of half a million of the young of this insect, the result of the increase from a few thousand which were kept on hand during the summer.

Another species, *Monodontomerus*, which attacks the freshly formed pupæ of the gypsy and brown-tail moths, and which hibernates as an adult within the winter nests of the last-named species, has shown a rate of increase and of spread under natural conditions in Massachusetts which is almost incredible. It has been secured from brown-tail moth nests in no less than six different and widely separated towns this winter, and, while the numbers present in each instance were small, the wide dissemination of this parasite means that an astonishing number are present in the aggregate.

One of the features of the work for 1908 was the rearing and liberating of more than 12,000 of a small species of *Apanteles* which attacks the brown-tail caterpillars in the fall, before they have entered their hibernating webs. The young parasite lives within these caterpillars, without causing them inconvenience, until after they have emerged from their webs and have fed for a period in the spring. At about the time when the healthy caterpillars pass their first spring molt the parasitized individuals die, and the parasite larva emerges and spins a cocoon similar in appearance to that of the Japanese parasite, but, unlike that species, always solitary. The handling and feeding of large numbers of caterpillars necessary to produce 12,000 of these adult parasites by means of any of the appliances for this purpose ordinarily in use in entomological laboratories was wholly impracticable, and made imperative some new device.

This was finally secured by a radical modification of the method used for the rearing of silk worms. Specially constructed trays were employed, from which the caterpillars were prevented from escaping by a band of "tangle-foot;" and complete success, so far as the laboratory end of the work was concerned, was secured. The successful establishment of the parasite could not be determined until the spring of 1909, under any circumstances, but it is confidently expected that it will be recovered from the vicinity of the colonies at that time.

It is desired during 1909 to continue the importation of parasitized caterpillars and pupæ of gypsy and brown-tail moths, as in the past, and to make especial efforts to secure considerable quantities of the living parasites of those species which it has been found impossible to secure living and in numbers heretofore. The work of importation has proved much more difficult than was anticipated. In certain respects the method of collecting and shipping the European material has proved to be inadequate, and while it permits of some among the numbers of parasites to reach their destination in safety, it is fatal to others, among which are some of the most promising. To correct these faults it is hoped that arrangements may be made for the establishment of a shipping station in Russia, under the direction of Professor Kincaid, who has demonstrated his remarkable ability in this line during the past year in Japan. The selection of Russia as a site for the proposed operations has been made after a great deal of deliberation, and a full consideration of all of the advantages and disadvantages of such a selection. The problem of successful transportation of the parasites or of the parasitized caterpillars is great, and will require especial arrangements with the transportation companies and with the Russian government itself, in order to secure the celerity of dispatch which is absolutely necessary for success, and the avoidance of an examination of the packages at the frontier. These disadvantages are, in the opinion of those responsible for the selection, more than offset by the greater abundance at the present time of the gypsy moth and of its parasites in this section of Europe.

A trip made by Mr. Fiske in September, 1908, into southwestern France, where it was first intended to establish this

station, indicated the unfitness of this section, since at the present time the gypsy moth is very rare there. It is necessary, for the success of the undertaking, that the material shall be packed properly during the early as well as the later stages of its transmission from the field to the laboratory. Without the skill displayed by Professor Kincaid in packing the material collected by him in Japan last season, the results of his trip would have been relatively insignificant.

The entire proposition of introducing the parasites of the gypsy moth is unique, even among other attempts which have been made along similar lines. The insect which it is desired to control differs so materially in habit from any which have been the subject of similar attempts in the past as to make it necessary to devise entirely new methods for handling its parasites, many of which are themselves different in habit and character from any hitherto handled. The fact that they may only be secured in connection with the gypsy or brown-tail moth caterpillars or pupæ makes it a question of success upon the first effort, or of delay for an entire year for a recurrence of the proper season.

The same is true of practically every phase of the work. It is rarely indeed that the success of an attempt at colonization of any species becomes apparent until a full year after the colony is planted; and failure cannot positively be determined until several years have elapsed, allowing for an increase in the abundance of the insect until its presence shall become apparent.

It is in this respect more than in any other that this undertaking differs so radically from the importation of such parasites as those of scale insects, for example, which pass through several generations annually, thus making the experience which has been gained by work upon such insects and their parasites of practically no value.

REPORT OF PROF. FILIPPO SILVESTRI OF THE ROYAL SCHOOL
OF AGRICULTURE, PORTICI, ITALY.

In July of this year Prof. Filippo Silvestri of the Royal School of Agriculture at Portici came to this country, and by invitation of Superintendent Kirkland made a visit to the infested district around Boston and to our parasite laboratory at

Melrose Highlands. Superintendent Kirkland asked him to give us an expression of his opinion in regard to the methods used in carrying on the work, and also on the methods used in importing and breeding parasites, and he submitted to us the following report:—

NEW YORK, July 20, 1908.

TO MR. A. H. KIRKLAND.

I made a visit to your laboratory at Melrose Highlands, where the parasites of *Lymantria*¹ and *Euproctis*¹ received from Europe and Japan are developed. I have visited a large part of the surroundings of Boston where the war against these insects is carried on by artificial methods, and also the places where they have been allowed to spend all their activity. I have read the three annual reports of the work accomplished in 1905, 1906 and 1907, as you desired my full and frank opinion about the work which is being done under your direction, and also my opinion as to what seems likely to occur in the future, and I herewith make it with the greatest pleasure. I will begin by saying that the two insects mentioned above are a veritable pest of much importance on trees of North America, and that if left unmolested they will finally occupy almost all the temperate regions of North America, causing incalculable damage. *Lymantria* and *Euproctis* are insects introduced from Europe without their parasites; therefore here we do not find the natural check which in Europe in the case of many insects usually destroys them in such quantities that they are reduced to such small numbers as to be unnoticed. It is possible in Europe in some years also to have a serious enemy in special climatic conditions, which favor the development of infectious diseases caused by different bacteria and fungi; but these conditions are not under control, and naturally do not occur with much frequency, and, although they are of economic value, yet they cannot be relied upon to the extent of giving up artificial suppression. Nevertheless, I believe that it would be useful to have competent persons study the maladies to which *Lymantria* and *Euproctis* are subject in Europe and elsewhere, although only such persons as are competent to identify the same should be employed in the work.

The spirit manifested by the Congress of Massachusetts at the beginning of the work was excellent and extremely patriotic, inasmuch as they contemplated the complete extermination of *Lymantria* and *Euproctis* in America; but no entomologist of the present or of the future I believe will be able by any means to attain to complete extermination of an insect so scattered through woodlands and on various kinds of vegetation. Will it be possible in such a case to attain the complete suppression, and, if that is not possible, to fight these insects

¹ Generic names of the gypsy moth and the brown-tail moth.

so that their numbers can be kept down so as to be unnoticed from an economic point of view? They are now known to be scattered over 3,140 square miles, notwithstanding that in America they have fought them with excellent methods; and it seems to me impossible, at least not probable, that an artificial warfare should be kept up against such insects all over the territory infested. Therefore, the fight ought to be continued as much as possible, as under your direction it has been started, especially along the roads, to prevent the carrying of larvæ on vehicles of every kind into the surrounding territory. Also, I think it is necessary that the infested area should be decreased as far as possible without observing the expense in such a case.

In regard to the artificial suppressive measures used in fighting the gypsy and brown-tail moths, it seems to me that at the present none could be better than those used by you. Notwithstanding, therefore, all that the financial power of North America can accomplish in combating artificially these insects, I am convinced that they will not succeed by such means in preventing the invasion of other States in the future; and that, notwithstanding the enormous expense which is annually sustained by private individuals, municipalities, the State and the nation, there will always be great damage. Such being the hard facts, I am only able to give my praise, with that of the other eminent entomologists, to the one who first thought of introducing the parasites of the gypsy and the brown-tail moths from Europe and Japan to assist in the fight against them. I believe that to none other less capable than Prof. L. O. Howard should be confided the direction of this work of introducing and rearing the parasites of the two injurious lepidoptera, and I fully approve the methods followed in the shipment of the parasites from Europe and Japan, — a good method, which only experience and skill can improve. The methods which I have seen in practice at the laboratory at Melrose Highlands for the care of the parasites collected from Europe and Japan, and the methods used in the breeding of the same, appear to me good; also, the results already obtained in acclimatizing the *Calosoma sycophanta* are almost incredible. This insect is a beetle which is most active in Europe in all stages of larva and adult in destroying the larvæ of the gypsy moth, and there is much hope to be placed on the work of this first enemy now secured in this fight against the gypsy moth. I, for my part, do not doubt of the acclimatization in America of various species of parasites from the different orders of Hymenoptera and Diptera which have been and will be introduced; also, I have no doubt of their value in the fight against the gypsy moth, provided they are introduced without their secondary parasites. I have seen that at the laboratory at Melrose Highlands the greatest care is used in separating the primary from the secondary; but to lay particular stress on this part of the work on the parasites will not be superfluous, above all, that care should be taken to make sure of the true degree of worth of the para-

sites by study of the biology of the parasites of *Lymantria* and *Euproctis* in the country of their origin.

I believe it will be necessary to study the biology of all parasites that are at all known in parts of Europe and Japan, because I am convinced that the biological knowledge of these insects is the true base of economic entomology; and that in this special case, where you wish to make use of parasitic insects to fight another insect, it is indispensable to have a profound knowledge of their biology. Therefore, I believe that without doubt the biological study of the parasites of the two injurious species of Lepidoptera, in Europe, Japan, and possibly also in the Asiatic continent, ought to be entrusted to a competent person. After such study they will be able to determine surely the true rank of the parasites of various species of Hymenoptera, to kill all secondary parasites and to liberate instead only those which are of the first rank, and among these last, if possible, those only that are of special importance in combating *Lymantria* and *Euproctis*. In the study of the biology there will be brought to light many interesting facts, which will enable those engaged in the work to obtain a sure result, and in the shortest possible time. It seems to me also that it will be necessary to increase the number of entomologists who are occupying themselves with the biology of the parasites in Massachusetts, and that they should occupy a larger laboratory, where the sheds in which they work may be more dispersed, so that the temperature will not be too high, as it happens now in the large shed situated near the laboratory.

To protect as much as possible the parasites that are now introduced, it will be advisable to reserve for breeding places in the central part of the infested territory a certain number of localities some miles apart. Of such localities one should be for the *Calosoma sycophanta*, because, being a predatory insect, it should not be in the same place as the Hymenopterous parasites; and the other localities for the Hymenoptera and Diptera should be reserved as much as possible for the species of parasites of the various orders, so that each species should remain alone for some time to combat in a given locality the gypsy moth and the brown-tail moth. In the localities reserved for the action of the parasites artificial suppressive measures against the two Lepidoptera should not be carried on to extremes, but only such as are necessary to reduce the insects in numbers so that the trees surrounding shall not be defoliated, but so as always to leave a sufficient number for the parasites. Such partial artificial methods ought to be directed against the egg when there are plantings of the parasites which attack the larvæ and pupæ, and against the larvæ in turn when the parasites attack the eggs. By such methods I believe the best conditions possible for favoring the multiplication of the parasites in the field will be obtained, and the beneficial results from the introduction of the same parasites will be hastened.

In conclusion, I recommend the following:—

1. The artificial suppressive measures to be carried on with vigor wherever it is possible and convenient, except in the locality in the central part of the infested territory set apart for the multiplication of the parasites.

2. Vigorous suppressive measures along the streets and on the borders of the infested territory, in order to prevent as much as possible the extension of the area of infestation.

3. The study of the biology of the parasites in Europe and in Japan, in order to profit by such study in the introduction and rearing of parasites.

4. The continuation of the collection of parasites in Europe and in Japan, liberating the same in America in localities set apart for each species of parasites that are recognized surely to be of the first rank.

What will be the final result of this fight? I believe that the results will be the best, because as far as I can see it seems that there can be no obstacle in the way of acclimatizing in America some at least of the parasites of *Lymantria* and *Euproctis*, and that surely at the end of some years there will be a large number of parasites working against these insects. For some years, then, it will be well to continue the suppressive artificial methods, only being careful not to destroy the parasites (a thing that will be in part at least possible); and after the work is left to the parasites, the specimens of the gypsy and brown-tail moth will be reduced to a negligible number. It is well known that they still have in Europe serious infestations of these insects at intervals. This is because the parasites have in their turn other enemies, primarily among these other parasites. Here in America, if care is taken not to liberate the secondary parasites with the primary parasites, the gypsy moth and brown-tail moth will always have many enemies.

Also, if the final result of the introduction of the parasites should not be as happy as it is foreseen, nevertheless, it would be sufficient to accomplish by their means the result of combating efficiently enough the gypsy and brown-tail moths.

Therefore, I for my part felicitate you and Professor Howard for what you have done both in science and in practice, and so much the more that in the present case the national economy, whose prosperity stands highly to every citizen of the United States, is seriously concerned.

Perseverance, then, and confidence in this warfare, since I believe your success will be complete, at least if nature does not conceal some new and unexpected weapon of defense.

I thank you for the kind invitation to expound fully my opinion about the work under your direction, and with best wishes for your distinguished health, I am,

Yours most sincerely,

FILIPPO SILVESTRI.

REPORT OF DR. L. O. HOWARD, CHIEF OF THE BUREAU OF
ENTOMOLOGY, WASHINGTON, D. C.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY, WASHINGTON, D. C., Jan. 4, 1909.

MR. L. H. WORTHLEY, *Acting Superintendent for Suppression of Gypsy
and Brown-tail Moths, 6 Beacon Street, Boston, Mass.*

SIR:—I have the honor to submit a brief report of my efforts during the period since I submitted my last report to you, on Jan. 20, 1908, to import the foreign parasites of the gypsy and brown-tail moths into Massachusetts.

Respectfully yours, L. O. HOWARD, *Chief of Bureau.*

At the time of writing my last report the active work of the season in this direction was practically completed. In the autumn the parasite laboratory was moved from Saugus, Mass., to Melrose Highlands, Mass. The new location is much more accessible to Boston and to most of the field colonies of the parasites. The buildings, including several substantial structures built for laboratory purposes by the State of Massachusetts, are much better fitted for the work. Upon the whole, the results of the year's importations have been very promising.

In planning the work several features have been introduced. The parasites that are constantly being sent over by agents belong to three main groups, namely, those of the order Hymenoptera, including the Ichneumon flies, the Chalcids flies, and others; those of the order Diptera, including the Tachina flies; and those of the order Coleoptera, including the predaceous ground beetles. The amount of material received has been so great, and the character of the different life histories of the insects involved has been so diverse, that it has seemed of great importance to have a thoroughly trained expert, skilled in the biology of each group, placed in charge of each group. This has been done, and one expert has had charge of the Hymenoptera, another of the Diptera and another of the Coleoptera. Further, the condition of European sendings by mail and by express during the summer of 1907 was by no means uniformly good. The sendings from eastern Europe, which are subject to long railway journeys, in addition to the sea voyage, frequently arrived in bad condition. Therefore, an innovation was made, and a general laboratory depot was established at Rennes, France, under the general supervision of Mr. René Oberthür, and a skilled assistant, Mr. A. Vuillet, was placed in specific charge. Nearly all of the European sendings were shipped to Rennes, were examined, repacked, carried personally by Mr. Vuillet to Cherbourg or to Havre on the known days of sailing of certain steamers, then

placed in the hands of chief stewards of the vessels and carried in the cold room to New York, where they were admitted without examination and sent direct to Boston. This method has resulted in a much better average condition of the material received, and has facilitated the rapidity with which the work is being accomplished. The courtesy of the steamship officials is highly appreciated.

The third innovation has been an attempt to secure Japanese parasites of the gypsy moth. It has been known for some years that the true gypsy moth, or one of its varieties, or at least a most closely related species, occurs in Japan, though not in great numbers, and that it is apparently held in check by its parasites. Rev. H. Loomis, an American living in Yokohama, has repeatedly written to the State authorities of Massachusetts and to the United States Department of Agriculture, conveying this information; and attempts have been made by mail and otherwise to send these parasites to the United States, but without success. Later information, received from one of the most skilled economic entomologists of Japan, Mr. Nawa, indicated that there exists in Japan an important egg parasite of the gypsy moth. Remembering that the Massachusetts gypsy moth came originally from Europe, it seemed altogether desirable to introduce first the European parasites, and it seemed probable that these would by themselves re-establish the balance of nature. Then, too, the importation of the Japanese species seemed somewhat dangerous, on account of the chance that the Japanese gypsy moth might prove even more voracious and destructive than the European moth; but after mature consideration it was thought best to leave no stone unturned, and to neglect no chances in the search for effective parasites. The European service of collectors and agents and advisors had been well organized and instructed during three annual visits of the Chief of the Bureau to Europe; and it was therefore decided to interrupt the European trip for the present year, and to send an agent to Japan. Prof. Trevor Kincaid of the University of Washington, at Seattle, was chosen on account of his skill as a collector, evidenced in the remarkable results of the Harriman expedition to Alaska, his comparative proximity to Japan, and the fact that he is personally acquainted with many persons in Japan. He sailed on March 2, and the results of the expedition have more than justified the expense involved. A very large amount of parasitic material has been received from him in good condition at Boston, and very many parasites from Japan have been colonized in the woodlands of New England.

Still another decided innovation has been the carrying on of active winter work with parasites, especially those secured from imported nests of the brown-tail moth, which began to come in from Europe in December. It was found quite possible to breed these parasites in artificially heated rooms, feeding them upon hibernating native brown-tail moth larvæ brought in in their nests from out of doors, feed-

ing the latter upon lettuce and other hothouse foliage, and in the early spring securing more normal food for them by sending it up in boxes by mail from Washington and points south. In this way the breeding of the parasites of the genus *Pteromalus* was carried forward uninterruptedly throughout the winter, and, as during the breeding of successive generations they multiplied exceedingly, it was possible later in the year to liberate a vastly greater number of individuals than would have been possible had the imported species been allowed to hibernate normally in the nests. In the course of this work Mr. W. F. Fiske, in charge of the breeding operations, has invented a rearing tray which has been of the utmost advantage, and which will greatly facilitate parasite rearing work in the future.

Still a fifth innovation, and one of great value, has been the discovery and practice of retarding the development of brown-tail moth eggs by keeping them in cold storage until the arrival of the European egg parasites, which will oviposit upon and breed in these cold-storage eggs as freely as in those which they attack in the state of nature. This process, it has been ascertained, may be carried on for a long time, and successive generations of these egg parasites may be reared from eggs retarded in their development by cold storage. It is thus easy to breed and to liberate an almost infinitely greater number of these egg parasites, and under favorable conditions, than would be possible from a simple importation of European parasitized eggs which would have to arrive in America at a specific time. These latter innovations have been due to the ingenuity of Mr. Fiske.

In the same way great advance has been made in the rearing of the Tachinid parasites, under the charge of Mr. C. H. T. Townsend, who has devised methods and made observations that have greatly added to our knowledge of the biology of these insects, and have resulted in the accumulation of a store of information of the greatest practical value not only in the prosecution of the present undertaking, but in any problem of parasite introduction or control that may arise later. Extraordinary and almost revolutionary discoveries have been made in the life histories of certain of these flies, and without this knowledge the greatest success in handling them practically could not have been reached.

Similarly, Mr. A. F. Burgess, in charge of the Coleoptera, has succeeded in a very perfect way in rearing and liberating the important European predatory beetle (*Calosoma sycophanta*), as well as some other insects of the same family.

Altogether, down to July 1, 1908, the following material was imported:—

Brown-tail moth egg masses, about 26,000.

Hibernating nests of the brown-tail moth, from 50,000 to 60,000.

Free larvæ and pupæ of the brown-tail moth, about 178,000.

Gypsy moth egg masses, 7 boxes, each containing very many masses.



BREEDING CAGES AND TRAYS FOR PARASITES OF THE
BROWN-TAIL MOTH AT LABORATORY.

Gypsy moth larvæ and pupæ, about 161,000.

Gypsy moth larvæ from Japan, 8 large boxes, containing several thousand larvæ and parasite cocoons.

Predatory beetles, 2,892.

It will be noticed that only about half as many of the hibernating nests of the brown-tail moth were imported during the winter of 1907-08 as during the winter of 1906-07; but the smaller number is offset by the larger numbers of larvæ, pupæ and egg masses, so that the gross amount received is about the same as that of the previous year. The material received from Japan listed above came in before July 1, but in all there have been received about 40 boxes, nearly all of large size. From one shipment of the cocoons between 40,000 and 50,000 adults of one of the most important parasites of the genus *Glyptapanteles* were reared and were liberated directly in the open.

The colonization work has been going on rapidly during the summer of 1908, and of the species colonized the following have been the most numerous: —

<i>Pteromalus</i> from the brown-tail moth nests,	114,000
<i>Trichogramma</i> from the brown-tail moth eggs,	11,600
<i>Telenomus</i> from brown-tail moth eggs,	4,560
<i>Apanteles</i> of the brown-tail moth,	12,875
Japanese <i>Glyptapanteles</i> ,	45,000
<i>Meteorus</i> from brown-tail moth,	1,080
<i>Pimpla</i> from brown-tail moth pupæ,	2,051
Unclassified Tachinids,	4,177
Named Tachinids,	1,600
<i>Calosoma sycophanta</i> , adults and larvæ,	978

thus making nearly 200,000 of the most active enemies of the gypsy moth and brown-tail moth liberated under the most favorable conditions during the year.

The results of the colonization work of previous years have not become very evident. It is altogether likely that the species introduced have found conditions favorable to their increase, and that at the present time they exist in considerable numbers. The area, however, is so extensive as to make their occurrence in ordinary collections a matter of chance rather than of likelihood. There have been during the past two years a tremendous destruction of the larvæ of both brown-tail moth and gypsy moth from bacterial and fungous diseases. These diseases have appeared in spots, but unfortunately some of these localities were those where colonies of parasites had been established, and in the wholesale destruction of the caterpillars by disease the introduced parasites must have suffered severely. Knowledge has been gained, however, which will make it more easy to select better localities for colonization in the future. Several of the parasites have been found to have estab-

lished themselves, and notably the predatory beetle (*Calosoma sycophanta*) has been found in numbers. At least seven species have been found under conditions which indicate their establishment.

There have been imported, in all, 23 species of Hymenopterous parasites, of which 16 are European, 6 are from Japan and 1 at least is common to both regions. Eleven of these have been reared from the gypsy moth, 6 from the brown-tail moth and 6 from both insects.

A number of species of secondary parasites have been reared and have been killed.

Of Dipterous parasites, at least 29 distinct species have been imported, of which nearly all are parasitic upon both gypsy moth and brown-tail moth.

Of Coleoptera, 5 species have been imported, all of which will feed upon both gypsy moth and brown-tail moth.

This makes a total of 57 beneficial species, enemies of gypsy moth or brown-tail moth, or both, that have been brought over in the course of this work.

All visitors to the laboratory at Melrose Highlands have been impressed, not only with the large size of the undertaking, but with the extreme care with which all operations have been conducted. Scientific men have been practically interested in many of the extremely novel discoveries that have been made in the life histories of the parasites and in practical methods of breeding. The whole subject of the proper operations in order to secure the best results proves to be more complicated than any one had supposed before this large-scale experiment was undertaken, and discoveries are being made almost daily of absolute novelty in the field of biological science.

Co-operative assistance in the work of carrying on some biological investigations suggested by the practical work, and for which the material is present in great quantity at the laboratory, has been gained through the kindness of Profs. E. L. Mark and W. M. Wheeler of Harvard University. It has been considered most desirable that the workers at the laboratory, whether they are paid by the State or by the United States Department of Agriculture, should devote their time exclusively to the immediate practical end of the investigation; but what appears to be the purely scientific aspect must not be neglected, since its study will in the future, as it has constantly done in the past, indicate points of practical value to the progress of the rapid establishment of the parasitic species. The writer considers himself and the State of Massachusetts particularly fortunate in securing the co-operation of the men just mentioned.

On the date of the present writing the cheering news comes from Mr. Fiske, in charge of the parasite laboratory at Melrose Highlands, that the European *Pteromalus* has emerged in gratifying numbers from brown-tail moth nests collected in the vicinity of one of the last spring colonies. The outlook is now more favorable than at any period during

the progress of the work. Success seems an ultimate certainty, but the time at which perfectly obvious results will be apparent is as yet uncertain. By perfectly obvious results I mean a marked diminution in the numbers of gypsy moth and brown-tail moth over a region of some extent, which by expert examination can be shown to have been brought about through the work of introduced parasites.

SUMMARY OF RECOMMENDATIONS.

Recommendations are: —

1. To continue the field work at its maximum efficiency, an appropriation of \$150,000, in addition to that already provided for the year 1909, should be made.
2. To continue the work of importation of parasites and for work on fungous and bacterial diseases, an appropriation of \$15,000, in addition to any unexpended balance, should be made.
3. To provide for the uninterrupted continuation of the work against the gypsy and brown-tail moths, that the work may not suffer from legislative delays in the winter and spring, when most effective work can be done, a suitable appropriation should be made for a period of at least three years.

